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AIR POLLUTION ASPECTS OF EMISSION SOURCES: PULP AND PAPER INDUSTRY

A BIBLIOGRAPHY WITH ABSTRACTS

ENVIRONMENTAL PROTECTION AGENCY

MARCH 1973

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Air Pollution Technical Information Center

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ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina

March 1973

170

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INTRODUCTION

The Air Pollution Technical Information Center (APTIC) of the Office of Air Quality Planning and Standards prepared, selected, and compiled the abstracts on the pulp and paper industry in this bibliography. The abstracts (approximately 700) are arranged within the 14 categories listed in the Contents. The abstracted documents are thought to be representative of the available literature; however, no claim is made to all-inclusiveness.

The subject and author indexes refer to the abstracts by category letter and accession number. The author index lists all authors individually; primary authorship is indicated by an asterisk. In general, higher accession numbers have been assigned to more recent documents.

Current information on the pulp and paper industry and many other air pollution-related subjects may be found in APTIC's monthly abstract bulletin.*

All of the documents abstracted by APTIC are currently on file at the Air Pollution Technical Information Center, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Readers outside the Environmental Protection Agency may seek the documents directly from publishers, authors, or libraries.

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* Air Pollution Abstracts, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Includes more than 6300 abstracts, subject and author indexes in each issue, and two separate cumulative indexes. Subscription price: $27.00 per year; $6.75 additional for foreign mailing.

A. EMISSION SOURCES

01644

I. B. Douglass and L. Price

A STUDY OF METHYL MERCAPTAN AND DIMETHYL SULFIDE FORMATION IN KRAFT PULPING. Tappi 49, (8) 335-42, Aug. 1966. (Presented at the 51st Annual Meeting, Technical Association of the Pulp and Paper Industry, New York City, Feb. 20-24, 1966.)

The formation of methyl mercaptan and dimethyl sulfide in kraft pulping has been studied with regard to the influence of wood type, temperature of cooking, sulfidity, and length of cooking. Digestions were carried out on a semimicro scale using, 1.0 g of wood and 4.0 ml of cooking liquor in a 7.5-ml stainless steel digester. Four types of wood, spruce, loblolly pine, red maple, and paper birch, were digested at 150, 160, 170, and 180C for 1,2,3, and 4 hr at 14.7,22.2 and 30.5% sulfidities. After completing each cook, the content of the digester was acidified to liberate methyl mercaptan and the amounts of organosulfur compounds formed were then determined by gas-liquid chromatography. Under comparable conditions, hardwoods produce more methyl mercaptan and dimethyl sulfide than softwoods. Cooks carried out at lower temperatures and for shorter times produce more mercaptan than sulfide but those carried out at higher temperatures and for longer periods, especially at high sulfidity, produce much more dimethyl sulfide than mercaptan. Curves prepared from the data clearly demonstrate that methyl mercaptan is the primary product and is consumed in the formation of dimethyl sulfide. Extrapolation of results obtained on this semimicro scale agree well with results reported from mill and pilot plant studies. (Author abstract)

01885

W. T. McKean, Jr., B. F. Hrutfiord, and K. V. Sarkanen

KINETIC ANALYSIS OF ODOR FORMATION IN THE KRAFT PULPING PROCESS I. Paper Trade J. 149, (35) 41-2, Aug. 30, 1965 and Tappi 48, (12) 699-704, Dec. 1965. (Presented at the National Meeting, American Inst. of Chemical Engineers, San Francisco, Calif., May 1965.)

The kinetics of the consecutive formation of methyl mercaptan and dimethyl sulfide at constant liquor composition were determined at several temperatures using a novel gas analysis based on vapor phase sampling. Comparison of kraft pulping of softwood and hardwood species shows that more organic sulfur compounds are produced from the latter group. In softwood pulping, a general enhancement in the reactivity of the lignin methoxyls occurs during the alkaline delignification process which results in accelerated odor formation during the last phase of pulping. The activation energies of these reactions suggest a substantial reduction in total formation of organic sulfur compounds may be accomplished by raising the reaction temperature and shortening the time of the kraft cook. The significance of the results to actual kraft pulping process is discussed. (Author abstract)

02274

F. E. Murray and H. B. Rayner

EMISSION OF HYDROGEN SULFIDE FROM KRAFT BLACK LIQUOR DURING DIRECT-CONTACT EVAPORATION. Tappi 48, (10) 588-93, Oct. 1965. (Presented at the Symposium on Water and Air Quality Control in the Pulp Industry, 56th National Meeting, American Inst. of Chemical Engineers, San Francisco, Calif., May 16-19, 1965.)

The emission of hydrogen sulfide during direct-contact evaporation of black liquor has been studied over a wide range of sodium sulfide concentrations and pH levels in the liquor and at various concentrations of hydrogen sulfide in the flue-gas stream entering the evaporator. Studies were conducted using a pilot-scale evaporator installed at an operating pulp mill, and the results were substantiated by observations on several full-scale operating evaporators. It was found that a direct-contact evaporator may emit hydrogen sulfide or may absorb hydrogen sulfide from the flue gases, depending upon conditions in the liquor and in the incoming gas stream. Emission of hydrogen sulfide is favored by high concentrations of sodium sulfide and low pH levels in the liquor, and by low concentrations of hydrogen sulfide in the flue gases entering the evaporator. Absorption of hydrogen sulfide into the black liquor occurs under conditions of high pH and low sodium sulfide concentrations in the liquor when the concentration of hydrogen sulfide in the inlet flue gas is relatively high. Absorption of hydrogen sulfide from the incoming flue gases was observed in all cases regardless of pH when the sodium sulfide concentration in the black liquor was reduced to zero by oxidation. Operating evaporators normally emit hydrogen sulfide, but the amount emitted varies greatly depending upon design and operating conditions. (Author abstract)

04345

D. D. Wangerin

WASTE-HEAT BOILERS - PRINCIPLES AND APPLICATIONS. Proc. Am. Power Conf. (Presented at the 26th Annual Meeting, American Power Conference, Chicago, Ill., Apr. 14-16, 1964.) 26, 682-91, Apr. 1964.

The special problems which the waste-heat boiler designer encounters are reviewed. Some of the more recent improvements in the utilization of waste by-products for steam generation are illustrated. The types of waste-heat boilers available are discussed. The discussion is limited to the utilization of the principal waste products available in three major industries - pulp and paper, steel, and petroleum. All of the waste fuels considered have characteristics that require special equipment-design considerations. Waste fuels are extremely poor when compared with the usual prime fuels. Many byproduct fuel or waste gases contain sufficient heat energy to make it economically feasible to generate steam for power and process use. Each waste fuel has a different characteristic, requiring a boiler of special design. But, all have very low heating values when compared with the usual prime fuels. In many cases, multiple-fuel-fired boilers can be designed to dispose of the waste product while minimizing the burning of the prime fuels.

So, with cost of prime fuels steadily rising over the years, waste products are more and more harnessed to provide part of industry's steam demands.

04879

I. B. Douglass, and L. Price

SOURCES OF ODOR IN THE KRAFT PROCESS. II. SOME REACTIONS IN THE RECOVERY FURNACE. Preprint. (Presented before the Odor Abatement Session, 52nd Annual Meeting, Technical Association of the Pulp and Paper Industry, New York City, Feb. 22, 1967.)

In the recovery furnace concentrated black liquor loses its remaining water and the residual solids then undergo pyrolysis. One may assume that the black liquor solids consist of lignin- and carbohydrate- derived organics and various inorganic sulfur-containing substances such as sodium sulfate, sodium sulfite, sodium thiosulfate, sodium sulfide or elemental sulfur. One series of experiments was carried out in which soda lignin was heated at 600 degree C with each of the inorganic substances listed and a second series in which each was heated with glucose. Sodium sulfate and sodium sulfite produced negligible amounts of hydrogen sulfide. With the other substances, however, both soda lignin and glucose converted 30-75% of the inorganic sulfur to hydrogen sulfide. These results clearly indicate the air pollution problem which will develop if the recovery furnace is operated in such a manner that complete combustion of the hydrogen sulfide does not occur. (Author abstract)

04893

Douglas, I. B.

THE CHEMISTRY OF POLLUTANT FORMATION IN KRAFT PULPING. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: U. S. Public Health Service, National Council for Stream Improvement, and University of Florida. Deland, Fla., E. O. Painter Printing Co., ((1966)), p. 41-71. 14 refs.

The emission of malodorous compounds from the digester arises from a stripping of hydrogen sulfide and from the reaction of sulfide or hydrosulfide ions with the methoxyl groups present in lignin. Methyl mercaptan is the primary product of the reaction but it reacts, as the mercaptide ion, in a more rapid secondary reaction to produce dimethyl sulfide. Hardwoods produce more malodorous compounds than soft woods. High temperatures, high sulfidity and long reaction time all favor the production of the sulfur compounds. There may be some production of malodorous compounds during the process of evaporation but it is not yet clear whether this is primarily a stripping action or whether there is additional formation of methyl mercaptan and dimethyl sulfide. The biggest sources of odorous compounds are the direct evaporator and the recovery furnace. Black liquor oxidation will largely eliminate the problem of the direct evaporator. The recovery furnace, however, presents a more serious problem since it is often overloaded and when this occurs large quantities of hydrogen sulfide, methylated sulfur compounds and sulfur compounds with two- and three-carbon groups will be emitted. (Author's abstract)

06240

Y. Suzuki, K. Nishiyama, M. Oe, and F. Kametani

STUDIES ON THE PREVENTION OF PUBLIC NUISANCE BY THE EXHAUST GASES FROM THE KRAFT PULP MILL. (PART I. ANALYSIS OF EXHAUST GASES.) ((Tohoku J. Exp. Med. (Tokyo))) 11 (2), 120-6 (Aug. 1964). (Presented at the 37th Annual Meeting, Japan Society of Industrial Medicine, Kurume, Apr. 7, 1964.)

Exhaust gases of a Japanese kraft pulp mill were analyzed. The reported results were as follows: In the stack gases were contained: 0.259 g/cc of sodium sulfate, 750 ppm of hydrogen sulfide, 196 ppm of sulfur dioxide and organic compounds of sulfur. The organic sulfur compounds were as follows in order of amount: methyl mercaptan, dimethyl sulfide, isopropyl mercaptan, dimethyl disulfide, propyl mercaptan or ethyl methyl sulfide, diethyl sulfide and ethyl mercaptan. The amount of dimethyl sulfide was 8.7 ppm. Organic sulfur compounds in the gases in the upper part of the Jansson screen were of the same composition as those in the stack gases, but the arrangement of the constituents in order of amount are somewhat different. All of these gaseous sulfur compounds smell offensive and characterize the exhaust gases from a kraft pulp mill. (Author conclusion)

06981

06981 D. L. Brink, J. F. Thomas, K. H. Jones

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. III. A RATIONALE FOR CONTROLLING ODORS. Preprint. 1967.

In processing concentrated kraft black liquor the recovery furnace has been designed to carry out several unit operations and processes simultaneously but without specific control on the individual functions. A program of research is being conducted to isolate and study these functions independently in the laboratory. Conceptual designs are presented which are being studied with the objective of providing information that could result in improvements in recovery furnace operation. Such improvements could include greater control in operation -- particularly in combustion phases, improved startup and shutdown procedures, elimination of the hazard associated with smelt explosions, and minimizing emissions of malodorous products. The basis for the conceptual design has been provided through an investigation with particular emphasis on pyrolysis of black liquor solids--one of the critical furnace functions. Pyrolysis, studied previously by a batch technique and currently by a continuous steady state operation, has been shown to produce large volumes of highly combustible gases containing high percentages of the total sulfur in black liquor solids. The volatile sulfur compounds comprise a malodorous array with a composition that is highly temperature dependent. (Authors' abstract)

08359

Feuerstein, D. L., J. F. Thomas, and D. L. Brink

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. I. PYROLYSIS AND COMBUSTION ASPECTS. TAPPI, 50(6):258-262, June 1967. 7 refs. (Presented at the 51st Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21-24, 1966.)

The production of malodors is an undesirable side effect that has always been associated with the kraft pulping process. Such malodors may originate at six major points in the overall digestion and combined recovery (inorganic chemical and heat) and organic waste elimination processes. Based on information in the literature, these points may be listed in order of decreasing contribution to atmospheric pollution: the recovery furnace is the major source, followed by evaporators, digester, lime kiln, oxidation tower, and dissolving tank. In the present study it was assumed that the recovery furnace operation

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08363

Jarvela, Oiva and Hannu Makkonen

INFLUENCE OF COOKING CONDITIONS IN TWO-STAGE POLYSULFIDE PULPING II. COOKING VARIABLES. TAPPI, 50(3):148-150, March 1968. 19 refs.

The optimization of the two-stage polysulfide cooking of pinewood was investigated. The cooking conditions were varied to give optimum results for pulping yield and papermaking properties of the pulp. The main part of the investigation was carried out according to a statistical program and, in addition, miscellaneous test cooks were made. The results indicate that on cooking with pure chemicals, the pulping yield incra pure chemicals, the pulping yield increases as the impregnation time is shortened. In a study of the recirculation process with a makeup black liquor, when pure chemicals were added, certain optima were found for the pulping yield and for the properties of the pulp. Addition of carbonate to the impregnation liquor or vapor phase polysulfide digestion showed no essential differences from normal polysulfide digestion, nor did dry impregnation, simulating penetration on a chip conveyor and immersion penetration. However, after prolonged impregnation, lower yield and inferior tearing strength were observed. Finally, a proposed mechanism for two-stage pulping is described. (Authors' abstract, modified)

08367

G. H. Tomlinson, II

TRENDS AND DEVELOPMENTS IN PULPING. TAPPI, 49(9):377-382, Sept. 1966. 19 refs.

No entirely new pulping processes have supplanted the original mechanical, alkaline and acid processes developed in the last century, but important technical changes have and are occurring. In each of these processes new generation pulp and/or processing techniques are developing. In mechanical pulping chip groundwood is finding special advantages in relation to pulp qualities; a modification involving a mild chemical pretreatment of the chips allows use of the dense hardwoods for such pulps. The efficient modern alkaline pulp mill has evolved as a result of development of improved recovery methods. Such techniques as countercurrent or vapor-phase cooking, the use of higher sulfidity liquor, and the addition of polysulfide can lead to further major change. The conventional calcium base sulfite process has lost considerable ground, at least in part, because of the lack of a chemical recovery process. Development of methods of recovery of magnesia and soda base liquors together with the greater versatility of the soluble base in relation to the cooking process has resulted in the conversion of old mills and the construction of new ones. New generation pulps-Magnefite and multistage Magnefite, Stora, Sivola and sodium bisulfite pulps-allow greater strength and/or greater variety of qualities than were possible with the calcium base. Expected future development of by-products and development of specialized qualities in the pulps are expected to lead to further changes in pulp technology. (Author's abstract, modified)

08368

Wenzl, Hermann F. J. and O. V. Ingruber

EFFECT OF THE VARIOUS COOKING CHEMICALS IN KRAFT PULPING. Paper Trade J., p. 33-38, Aug. 1, 1966. 59 refs.

Literature reporting the behavior of various chemicals utilized in the kraft pulping process is reviewed. These include sodium hydroxide, sodium sulfide, sodium polysulfide, and sodium borohydride. The following areas are discussed: role of alkali; rapid alkaline pulping; sulphur component; inorganic reactions of liquor components; cooking with polysulphides; and reducing additives. The bibliography consists of 59 references.

08631

CHEAPER ClO2 PROMISED BY NEW ROUTES. Can. Chem. Process., 51(3):64-66, March 1967.

Prospects for a bleached kraft mill operating on a closed chemical system have been enhanced by the latest R-2 process development, which incorporates a new reactor set-up to permit low-cost recovery of by-product sodium sulfate. The cost of chlorine dioxide relative to chlorine is the major consideration in deciding whether ClO2 will be widely applied in the chlorination(1st) stage of a bleaching sequence. Of the possible approaches to chlorine dioxide generation at the pulp-mill, two major on-site routes are the main contenders: the electrolytic route and the chlorate reduction route. It was discovered that the chloride ion effectively reduces chlorate ion to chlorine dioxide. Thus, it became possible to feed a ClO2 generator with sodium chlorate, sodium chloride, and sulfuric acid rather than the chlorate, sulfur dioxide, and the sulfuric acid. The switch also meant that R-2 plants could be lower in capital costs for a given ClO2/Cl2 tonnage. Since its first full-scale use in 1960, the R-2 process has been installed at 26 (out of 80-odd) pulpmills in North America, many of them in southern USA. These R-2 plants account for about 40 percent of ClO2 generated for pulp bleaching. As these southern US R-2 plants became fully depreciated, the chemical cost of ClO2 was as low as 10 cents/lb in some cases (that is, to 3.8 cents/lb of equivalent chlorine).

09011

Wenzl, Herman F. J., and O. V. Ingruber

PRINCIPLES AND PRACTICES OF KRAFT BLACK LIQUOR EVAPORATION. Paper Trade J., Vol. 150, p. 51-56, Nov. 28, 0966. 16 refs.

The properties of black liquor are discussed in relationship to the multiple effect, thermal compression and Bergstrom-Trobeck evaporation processes. The problem of scaling during evaporation and the removal of such scales is also discussed.

09202

Gladding, James N.

RECOVERY BOILER CONTROL. TAPPI, 49(5):112A-115A, May 1966. (Presented at the 20th Engineering Conference of the Technical Association of the Pulp and Paper Industry, Minneapolis, Minn., Sept. 12-16, 1965.)

The development of chemical recovery and the evolution of the equipment and the application of instrumentation from its early beginning (1880) up to the present day in the pulping industry are described. In the last 30 years developments in both the boiler and instrument industries have permitted the evolution of the recovery system from all that was entirely oriented to the chemical process through manufacture of steam as a byproduct to the present time when both steam generation and recovery of chemicals can be done efficiently. At the present time multiple units are being controlled in a central control room with the instrumentation, as far as combustion control is concerned, approximating that of modern power boilers. The efficiencies of the liquor systems have been increased by the development of instrumentations which will more precisely control the density of the liquors entering and leaving the boiler plant. Accidents in recent years have pointed up the necessity for additional safety controls on the auxiliary fuel systems, fire control systems on the liquor evaporation, and for established systems for emergency shutdown of the boilers (Author's abstract, modified)

09415

Murray, F. E.and H. B. Rayner

THE EMISSION OF HYDROGEN SULPHIDE FROM KRAFT RECOVERY FURNACES. Pulp Paper Mag. Can. (Gardenvale), 69(5):71-74, March 1, 1968. 5 refs. (Presented at the 3rd Paper Industry Air and Stream Improvement Conference, Van- couver, B. C., Oct. 23-26, 1967.)

In a study extending over several months at a kraft pulp mill, the emission of hydrogen sulphide from a recovery furnace was measured many times. Simultaneous measurements of flue-gas oxygen content, rate of black liquor solids flow, and total, primary and secondary air flow to the furnace were recorded. The amount of H2S in the flue gases emerging from the economizer section of the boiler was found to vary from zero to about 700 microgram/l. It varied with the rate of solids flow to the furnace, with the total and secondary air flow rate and appeared to be independent of the primary air flow rate.

09686

R. L. Duprey

COMPILATION OF AIR POLLUTANT EMISSION FACTORS. Public Health Service, Durham, N. C., National Center for Air Pollution Control, Publication No. 999-AP-42, 67p., 1968. 126 refs.

Detailed emission factors are given for the following processes and industries: fuel combustion, refuse incineration, chemicals, food and agriculture, metallurgical refining, minerals, petroleum, pulp and paper solvent evaporation and gasoline marketing, and transportation (vehicle emissions).

10524

Stuart, H. H., and R. E. Bailey

PERFORMANCE STUDY OF A LIME KILN AND SCRUBBER INSTALLATION. TAPPI, 48(5):104A-108A, May 1965. 1 ref.

A new 12 by 350 ft lime sludge kiln was designed to produce 335 tpd of 90% available CaO product a t fuel economy of 8,120,000 Btu/ton. The major problems encountered during the startup of the kiln have been corrected, and the kiln is presently producing lime with a fuel economy of 8,112,000 Btu per ton of product at 85% of the design capacity. The fuel economy is better than the design rating and can be improved by increasing the solids of the sludge feed from 55 to 65%. The lime presently produced by the kiln contains 86% available CaO, which is much lower than desirable. Steps to be taken to further improve the kiln operations and lime quality are: (1) the installation of a 11.5 for 11 1/2 X 14 ft precoat vacuum filter to deliver sludge to the kiln at 65% solids or better; (2) renovation of the green liquor clarifier and dregs washers, which is expected to reduce the impurities in the systems from 20-25% to 10-12%; (3) more storage capacity for the white and green liquor so minor interruptions in the recausticizing area will not affect kiln production and lime quality. The kiln is equipped with a Chemico type S-F Venturi scrubber for the removal of dust entrained in the exist stack gases. Test results show that the scrubber is removing 96-97% of the entrained dust at a pressure drop of 7-11 in. of water across the Venturi. No problems that would cause loss of kiln production have been encountered since the scrubber was started up in October 1963. (Authors' abstract, modified)

11144

Douglass, Irwin B.and Lawrence Price

SOURCES OF ODOR IN THE KRAFT PROCESS. II. REACTIONS FORMING HYDROGEN SULFIDE IN THE RECOVERY FURNACE. TAPPI, 51(10):465-467. Oct. 1968. 9 refs.

In the recovery furnace concentrated black liquor loses its remaining water and the residual solids then indergo pyrolysis. On may assume that the balck liquor solids consist of lignin- and car- bohydrate-derived organics and various inorganic sulfur containing substances such as sodium sulfate, sodium sulfite, sodium thiosulfate, sodium sulfide, or elemental sulfur. In two series of experiments, each of the inorganic substances listed was heated at 600 deg. C, first with soda lignin and then with glucose. In the experiments using sodium sulfate and sodium sulfite, negligible amounts of hydrogen sulfide were formed. In the experiments with elemental sulfur, sodium sulfide, and sodium thiosulfate, however, heating with soda lignin or glucose caused 30-75% of the inorganic sulfur to be converted to hydrogen sulfide. These results clearly indicate that in a recovery furnace large volumes of hydrogen sulfide are formed which, if the furnace is not operated properly may escape to the atmosphere and be a major cause of air pollution. (Authors' abstract)

12422

Lutz, G. A., S. B. Gross, J. B. Boatman, P. J. Moore, R. L. Darby, W. H. Veazie, and F. A. Butrico

DESIGN OF AN OVERVIEW SYSTEM FOR EVALUATING THE PUBLIC-HEALTH HAZARDS OF CHEMICALS IN THE ENVIRONMENT. VOLUME I. TEST-CASE STUDIES. (FINAL REPORT). Battelle Memorial Inst., Columbus, Ohio, Columbus Labs., Contract PH-86-66-165, 146p., July 1967. 203 refs.

Potential environmental health hazards due to the utilization of mercury, nickel, vanadium, fluorocarbons, and the chemicals used by the pulp and paper industry were reviewed. Pertinent information was identified and selected by examining appropriate subject indexes of journals, abstracts, and current periodicals. The combined activities of collection and evaluation were directed specifically toward the following interpretations: current status of environmental contamination by each of the five contaminants, current status of environment-related medical knowledge of the effects of the contaminant, technological changes likely to lead to the entrance of new contaminants of the selected types, demographic-related changes that would affect the degree of population exposure to the contaminants, and deficiencies in the available information. The studies revealed potentially hazardous situations. Mercury showed a substantial increase in the amount used in the electrolytic production of chlorine. There also exists a lack of fundamental information on national levels of mercury in air, water, and food. The vanadium study showed a significantly increased usage of volatile compounds in industrial applications. The nickel study raised the question of possible chronic effects of small quantities of nickel in food from the use of large quantities of nickel equipment in food processing. A need was demonstrated for the establishment of the environmental fate of fluorocarbons used in aerosols and refrigerants. A review of information on chemical processes employed by the pulp and paper industry demonstrated the need for surveillance of the atmospheric pollutants resulting from increased use of kraft pulping operations. Economics information and the toxicity of the five contaminants were discussed in detail.

12507

Murray, F. E.

AIR POLLUTION FROM BIVALENT SULFUR COMPOUNDS IN THE PULP INDUSTRY. Preprint, Engineering Inst. of Canada, 16p., 1968. 10 refs. (Presented at the Banff Pollution Conference, Banff, Alberta, Can., March 1968.)

In the kraft process of producing chemical cellulose from wood chips, the chips are cooked in a solution containing sodium hydroxide and sodium sulfide in about a four-to-one proportion. This method produces much greater air pollution, in the form of highly malodorous compounds, than the alternative sulfite processes. The three primary sources of odor production in a kraft pulp mill are the digestion process, the direct-contact evaporator, and the recovery furnance. In the digestion process, control must be effected on the noncondensible gases from the digester and blow tank, from the multiple-effect evaporators, and on the foul condensates that are formed in contact with these gases. The emission of hydrogen sulfide from black liquor during direct contact evaporation can be very substantially reduced by oxidation of the sulfide. The problem of the recovery furnance is one of good operation and combustion control within the furnace design capacity. Present laboratory studies are expected to lead to continuing improvement in the control of odorous emission from kraft pulping operations.

12621

Benjamin, M., I. B. Douglass, G. A. Hansen, W. D. Major, A. J. Navarre, and H. J. Yarger

A GENERAL DESCRIPTION OF COMMERCIAL WOOD PULPING AND BLEACHING PROCESSES. TI-9 Pulp and Paper Committee. J. Air Pollution Control Assoc., 19(3):155-61, Mar. 1969.

The purpose of Informative Report No. 1, prepared by the TI-9 Pulp and Paper Committee of the air Pollution Control Association, is to present a general description of the commonly used processes for preparing and bleaching wood pulp. Further reports of a more specific nature will be published as these become available. (Author's Abstract)

13192

Kott, Gary L.

PROCESS COMPUTER CONTROL OF A BLEACH PLANT. Tappi, 50(7):41A- 42A, July 1967.

A bleaching process is described which is controlled by seven closed supervisory loops. The system uses 14 instrument inputs, manual entries, and appropriate programs and hardware. Data collection, personnel orientation, and project maintenance are also important to the computer control project. This method has produced a stable bleaching process, which is thought to be superior to conventional control. (Author abstract modified)

13199

Aldrich, Lyman C.

KRAFT COOKING LIQUOR PREPARED FROM LIQUID SODIUM HYDROSULFIDE AND CAUSTIC SODA. Southern Pulp Paper Mfr., 30(6):74-75, 78-80, June 10, 1967.

Liquid sodium hydrosulfide and liquid caustic soda are the active chemicals in a synthetic white cooking liquor that can be used to fill the system for the initial start-up of new kraft pulp mills. The two chemicals react to form sodium sulfide which, together with caustic soda, separates lignin from wood fibers. The synthetic liquor can be prepared from 45% sodium hydrosulfide and 50% caustic soda, using the normal kraft mill recovery equipment. Because the large volumes of synthetic cooking liquor for start-up are prepared only once, no more than minimal extra equipment is needed. Because both sodium hydrosulfide and caustic soda produce severe burns, personnel involved in the unloading and mixing operations should use shields and protective rubber equipment. Since there is less generation of H2S at high pH values, the sodium hydrosulfide should be mixed with dilute caustic soda as soon as possible. Synthetic cooking liquor will have the same concentration of H2S as is found in a kraft mill operating with regular cooking liquor. Therefore, standard kraft mill ventilation and safety precautions are sufficient.

13237

Monsalud, Manuel R., Pablo M. Nicolas, and Felix G. Tadena, Jr.

BLEACHED SULFATE PULPS FROM WHITE LAUAN (PENTACME CONTORTA (VID.) MERR. AND ROLFE). Tappi, 48(7):430-432, July 1965. 2 refs.

Different bleaching processes were used and the effect of each on the bleached pulp yield and the pulp strength properties and brightness were determined. A three-stage bleach using a combined chlorine-chlorite in the first stage followed by caustic extraction in the second stage and sodium chlorite in the third stage produced a very good yield of high-quality bleached sulfate pulp of medium brightness. Another three-stage bleach of C-E-H sequence and two four-stage bleaches of C-E-C-H and C-E H-P sequences also produced good yields of high-quality medium-brightness paper pulps that were comparable to or better than the commercial bleached pulps used as references. (Author abstract modified)

13238

Annergren, Goran, Ake Backlund, Johan Richter, and Sven Rydholm

CONTINUOUS PREHYDROLYSIS-KRAFT COOKING. Tappi, 48(7):52A-56A, July 1965. (Presented at the 50th Annual Meeting, Tech. Assoc. of the Pulp and Paper Industry, New York, Feb. 21-25, 1965).

Continuous prehydrolysis-kraft cooking was tried on a semicommercial scale in Kamyr digesters of different designs. Extensive trials with a two-body upflow-downflow digester and a conventional downflow digester indicated that the two cooking stages could be effectively separated in both systems and that a pulp of satisfactory quality could be produced. Deposition of pitch on strainers and heat exchangers with liquor phase prehydrolysis, however, caused operational problems and limited the time of trouble-free operation. A successful operation was finally achieved in a downflow digester where an inclined external top separator replaced the conventional one. This allowed operation of the prehydrolysis stage in vapor phase, which eliminated the pitch problem and also gave other advantages. The kraft cook is carried out in liquor phase, the liquor level forming the point of transition between the prehydrolysis and the kraft cooking stages. The kraft cook is preferably performed countercurrently and is followed by Hi-Heat washing. The system was tested in continuous operation for one month and found to be reliable, simple, and to give a good and uniform pulp quality, i.e., with little screenings, high alpha- cellulose content, and small variations in degree of polymerization and purity. (Author abstract modified)

13280

Smelt-Water Research Group

EXPLOSIONS IN KRAFT RECOVERY FURNACES. Southern Pulp Paper Mfr., 29(11):40-41, 44, 46, 48, Nov. 10, 1966.

The Smelt-Water Research Group was founded by 59 kraft pulping manufacturers to study the damaging explosions which occur in the kraft chemical recovery furnaces. Kraft recovery furnaces contain molten chemicals (smelt) which explode when contacted with water. A report of the findings and recommendations of the Smelt-Water Research Group is presented. A major result of the study was the identification of the physical nature of the smelt-water explosions and the effects of some of the factors influencing their occurrence and intensity. Water, or water solutions of any of the chemicals commonly present in the recovery furnace systems (other than black liquor at concentrations of 55 to 70% total solids or higher), can cause destructive explosions if permitted to contact molten smelt. Smelt-water explosions were shown in the laboratory to be noncombustible in nature. They were extremely rapid, with pressure peaks of about one millisecond duration, producing shock waves which frequently shattered graphite crucibles. High-speed motion pictures demonstrated that explosions originated at a point beneath the smelt surface and occurred very rapidly upon injection of water. All these facts are consistent with a hypothesis of encapsulation of submerged water by smelt to produce an initial explosion. As yet, however, the encapsulation mechanism has not been conclusively demonstrated and direct proof may be very difficult. Recommendations include not adding any water except black liquor, installing monitoring systems, and the use of air lances to aid combustion. The need for automatic shutdown installations is stressed.

13281

Kotzerke, Donald F.

HOW SCOTT PAPER INCREASES SULFITE PULP YIELD BY COOKING REJECTS. Am. Paper Ind., 48(8):39-40, 42, Aug. 1966.

Experiments were performed to determine which common cooking media would be best suited to economically utilize knotter rejects in sulfite pulp production. Sulfurous acid, acid sulfite, and bisulfite cooking media were rejected due to high bleach demand and high percent screening. The kraft process proved successful, but the soda medium was found to be equal in product quality and better economically. The knotter rejects required very little soda addition and additional sulfur was not required. The caustic cooking of upgraded rejects produced pulp of high quality, low percent screening, strength of approximately 80% of normal sulfite pulp, bleach demand in the 4 to 8% chlorine number range with easy bleaching characteristics and low shrinkage during bleaching.

13282

Fennell, F. L. and N. J. Stalter

ADVANTAGES OF HYDROGEN PEROXIDE FOR BLEACHING KRAFT PULP. Southern Pulp Paper Mfr., 30(9):92, 94, Sept. 10, 1967.

Du Pont is one of the nine U.S. kraft mills bleaching with peroxide to stabilize pulp brightness after heat aging. In the six-stage process used, the peroxide stage is preceded by one chlorine dioxide stage in the sequence chlorination-extraction-hypochlorite-chlorine dioxide-peroxide (CEHDP). A competitive method is the six-stage chlorination-extraction-hypochlorite- chlorine dioxide-extraction-chlorine dioxide (CEHDED) process. Comparative tests show that the EDP sequence increases pulp air-dry brightness from 88 to 91 and oven-dry brightness from 88 to 90. With the DED, process the brightness is 90 air-dry and 87.5 oven-dry. The 1967 cost for 90 oven-dry brightness with peroxide is $1.50 a ton above the peroxide bleaching costs for 88 oven-dry pulp. This advantage of two points in oven-dry brightness for the CEHDP process over the CEHDED sequence is the main reason for a peroxide process.

13325

Olsson, Jan-Erik and Olof Samuelson

INORGANIC REACTIONS DURING POLYSULFIDE COOKING. Svensk Papperstid., 69(20):703-710, Oct. 1966. 14 refs.

From the changes in concentration of polysulfide, thiosulfate, and sulfide during the polysulfide cooking of pine, it can be concluded that about 60% of the polysulfide sulfur is decomposed by disproportionation. This reaction is predominant during an early stage of the cooking. The rest of the polysulfide sulfur is mainly consumed in reactions with the organic material, primarily oxidations in which the polysulfide is reduced to sulfide. During the cooking, the sulfide concentration passes through a maximum. Its increase is explained by its formation in these two reactions and its decrease toward the end of cooking by the formation of organic sulfur compounds. The thiosulfate concentration increases rapidly during an early cooking stage, and, after passing through a maximum, the concentration decreases slightly. The decrease is explained by the decomposition of thiosulfate into polysulfide under conditions used in sulfate cooking. (Author abstract modified)

13380

Jansson, Lennart B.

PROCESS MODIFICATIONS IN KAMYR CONTINUOUS KRAFT COOKING SYSTEMS. Tappi, 46(5):296-301, May 1963. (Presented at the 16th Alkaline Pulping Conference, Tech. Assoc. of the Pulp and Paper Industry, Savannah, Ga., Nov. 1-2, 1962).

A description is given of the digester system from chip feed to discharge of stock. The various development stages of the cooking system are discussed in chronological order, starting with the hot blow process and followed by the cold blow and diffusion-extraction processes. Also, the high heat diffusion washing is described. Some operational data for diffusion- extraction and high heat diffusion washing are presented. (Author abstract modified)

13386

Dahm, H. P. and V. Loras

AUTOMATIC CONTROL OF PULP CHLORINATION. Tappi, 46(1):40-41, Jan. 1963. 20 refs.

A new ferrous-ferric oxidation-reduction system will give far better control of continuous pulp chlorination than the redox oxidation potential system. In contrast to the redox method, it is completely reversible and has a reproducible standard potential. Determination of chlorine is rapid and accurate and independent of the hydrolysis of the chlorine or the presence of chloride ions. In this method, the chlorine-containing sample is mixed in constant proportions with a standard solution of iron salts in which 80% of the iron ions are present in the ferrous state and 20% in the ferric state. The change of the ferrous/ ferric ratio is then measured as a concentration cell potential directly proportional to the amount of chlorine present.

13395

Beaujean, John and V. B. Bodenheimer

COLD CAUSTIC PULP FROM SINGLE STATE REFINING. Pulp Paper Mag. Can., 63(3):T168-200, 1962.

In order to minimize the costs of making cold caustic pulp, an atmospheric soak with single stage refining and refiner bleaching was tried. A cold caustic plant was built in order to achieve higher utilization of mixed hardwoods. The process steps are shown on a flowsheet. Since the biochemical oxygen demand is approximate 200 lbs/ton from a cold caustic plant, the excess liquor from the live bottom bin drainer conveyor was saved. Quality of product ranged from good to poor. In single stage refining about three-quarters of stock is refined to an excellent pulp; approximately one-quarter is predominately small shives. There was no problem setting a 60 brightness, economically. Freenesses were maintained at 350 to 400 Canadian Standard and refiner horsepower was approximately 30 hp days/ton. The cost of the plant was within the budgeted amount and actual maintenance costs were small.

13399

Gierer, Josef and Bernard Lenz

REACTION OF LIGNIN DURING SULPHATE COOKING. PART 6. FORMATION OF 1,2-GLYCOL GROUPS IN MILLED WOOD LIGNIN ON TREATMENT WITH 2N SODIUM HYDROXIDE AT 170 C. Svensk Papperstid. (Stockholm), 68(9):334-338, May 15, 1965. 16 refs.

The reliability of a proposed splitting mechanism for alkaline clevage of arylether bonds was experimentally proved by demon strating the presence of 1,2-glycol groups in alkali lignins and by estimating the frequency of these groups. Milled wood lignin (MWL) from Picea abies was treated with 2N sodium hydroxide at 170 C for 3 hrs. Two samples of the resulting alkali lignin, one of which had been subsequently methylated with diazomethane were oxidized with periodate. The consumptions of periodate, compared with those of treated and untreated diazomethane-methylate milled wood lignin indicated that 1,2-glycol groups (0.13 per methoxyl, originally present) are formed during the alkaline treatment. The presence of 1,2-glycol groups in alkali lignin was also supported by showing that carbonyl groups are formed on periodate oxidation of borohydride-reduced, diazomethane-methylated, alkali-treated milled wood lignin (IR spectrum and estimation by the hydroxylamine method). The results are consisten with the view that beta-arylether linkages in non-phenolic lignin units containing a free hydroxyl group at a neighboring carbon atom of the side-chain are split via the corresponding epoxy inter mediates into 1,2-glycol structures. (Authors' abstract modified)

13439

Shera, Brian L. and Joseph B. Heitman

RELATIONSHIP OF OXIDATION-REDUCTION POTENTIAL TO FREE AVAILABLE CHLORINE IN PULP CHLORINATION. A PRACTICAL APPLICATION TO THE STUDY OF PULP CHLORINATION. Tappi, 48(2):89-94, Feb. 1965. 6 refs. (Presented at the Third International Pulp Bleaching Conference, Tech. Assoc. of the Pulp and Paper Industry, Seattle, Wash., Aug. 17-20, 1964.)

Oxidation-reduction potential corp measurements and the free available chlorine determinations are of considerable use in the study of the chlorination phase. An appendix describes the analytical procedure for available free chlorine determination. Carbon tetrachloride was used to selectively dissolve and separate free available chlorine from the pulp chlorination liquor. Rapid decline in the ORP indicates that free available chlorine no longer exists and the carbon tetrachloride extraction method is used for confirmation. Pulp chlorinations at various chlorine dosages, temperatures, and retention times were analyzed. Higher chlorine dosages and/or higher temperatures alone or in combination accelerate the degradation of cellulose fibers over the same retention period. Reduced retention periods to compensate for increased temperatures at teach level of chlorine dosage will permit equivalent fiber delignification and minimize further degradation of the cellulose. (Author abstract modified)

13440

Aurell, Ronnie

INCREASING KRAFT PULP YIELD BY REDEPOSITION OF HEMICELLULOSES. Tappi, 48(2):80-84, Feb. 1965. 10 refs. (Presented at the Alkaline Pulping Conference, Atlanta, Ga., Oct. 28-30, 1964.)

During a kraft cook about 25% by weight of wood carbohydrates is lost. In a birch kraft cook the concentration of dissolved hemicelluloses in the cooking liquor reaches a maximum. Part of these hemicelluloses is subsequently regained by redeposition on the wood fibers; the major portion, however, is degraded in the cooking liquor and lost. By drawing off the cooking liquor at a time when the concentration of dissolved hemicellulose is high, completing the cook in the vapor phase (or by injecting alkali), and then returning the drawnoff liquor to the delignified chips to create suitable conditions for redeposition, it was possible to increase the total pulp yield. The redeposition is favored by a moderate lowering of the pH. By the use of liquor transfer a yield about 1% higher than the normal was obtained for birch cooks with an effective alkali charge of 17.5%. At higher charges the effect was more pronounced, a 1.5-2% higher yield being obtained with 22.5% effective alkali. For pine the same method gave no significant increase in the pulp yield, probably because there is a smaller amount of dissolved hemicelluloses in the cooking liquor. (Author's abstract modified)

13443

Rapson, W. H., M. Wayman, and C. B. Anderson

PAPER BLEACHING-A NEW PROCESS. Tappi, 48(2):65-72, Feb. 1965. 6 refs.

Procedures were developed for increasing brightness in paper by bleaching with peracetic acid, peroxide, and sodium or zinc hydrosulfite. A two-stage bleach in which peracetic acid was followed by zinc hydrosulfite was most effective. Bleaching time was extremely short, 1 or 2 min with the peroxide, and 5-30 sec with the other bleaching agents. A variety of papers were bleached by these processes. The brightness of commer-

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13444

Aurell, Ronnie and Nils Hartler

SULFATE COOKING WITH THE ADDITION OF REDUCING AGENTS. PART III. THE EFFECT OF ADDED SODIUM BOROHYDRIDE. Tappi, 46(4):209-215, April 1963. 36 refs.

The addition of sodium borohydride in pine kraft cooking resulted in a substantially increased yield. The consequences of the borohydride treatment are discussed. When the sulfate cook is preceded by prehydrolysis of the pinewood, the carbohydrates are extensively degraded and dissolved in the alkaline stage. The addition of sodium borohydride will diminish the degradation considerably. The importance of the alkali concentration to the yield in kraft pulping of birchwood is examined. The addition of sodium borohydride without lowering the charge of alkali will result in only a small gain. On lowering the charge of alkali correspondingly, the effect of the addition is considerable. Potassium borohydride had the same effect as sodium borohydride. The reduction with amineboranes was studied. Their effect was less than that of the borohydride. The effect of the borohydride was not changed by the addition of black liquor. The addition of a wetting agent, in order to improve the penetration and thereby the efficiency of the borohydride, gave no improvement. Little advantage was gained upon addition of EDTA in order to improve the stability of the borohydride. Sodium metaborate or tetraborate (borax), added to the cooking liquor, gave no gain. The same result was obtained on the addition of barium or calcium salts. Upon the pretreatment of pine chips with an alkaline solution of sodium borohydride, an increase in yield of 12-13 kg pulp per kg sodium borohydride resulted from the subsequent kraft cook. This is approximately twice as much as if the addition was made directly to the cooking liquor. Different conditions for the pretreatment were studied. The optimum conditions were 80 C, 1% $NaBH_4$ calculate on the wood, a liquor:wood ratio of 5, and 30 min treatment time. An applied pressure further improved the result. The use of borohydride in technical kraft cooking is, however, not economicall practical. (Author abstract modified)

13492

Ricca, Peter Mauro

A STUDY IN THE OXIDATION OF KRAFT BLACK LIQUOR. Thesis (Ph.D.), Florida Univ., Gainesville, Univ. Microfilms, Inc., 1968, 140p. 47 refs.

The oxidation of kraft black liquor with pure oxygen and a mixture of oxygen plus ozone at the temperature range 60 to 90 C was investigated to determine the feasibility of mill scale oxidation using pure oxygen, the fate of sulfur compounds during oxidation, and the possibility of limiting pulp odors with ozone. Physical and chemical parameters examined included temperature, oxidizing agent, oxygen partial pressure, and method of contact. The predominant inorganic reactions that occurred were the oxidation of sodium hydrosulfide to sodium polysulfide and sodium thio sulfate. The thiosulfate reaction was slightly reversible; the polysulfide was not. The mole ratio of polysulfide to thiosulfate formed by complete oxidation of the hydrosulfide was relatively independent of temperature. Oxidation below 60 C precipitated small quantities of amorphous sulfur droplets from the liquor which, upon aging, crystallized to rhombic sulfur. The optimum oxidation temperature was found to be between 60 and 75 C. Pure oxygen fixed the inorganic sulfides in the black liquor but had little effect on the odorous black-liquor constituents. Exhaust gases were effectively deodorized with 100 to 150 ppm at 25 C of ozone, and it is concluded that the non-condensable gases from evaporates and digesters can be similarly deodorized.

13594

Russell, Norman A.

THE INITIAL PHASE OF THE AQUEOUS CHLORINATION OF KRAFT PULP MEALS. TAPPI, 49(9):418-422, Sept. 1966. 20 refs. (Presented at the 51st Annual Meeting, Technical Assoc. of the Pulp and Paper Industry, New York, N. Y., Feb. 20-24, 1966.)

A tubular flow reactor was designed to investigate the rapid, initial phase of aqueous chlorination of kraft pulp. A substantial portion of the total chlorine consumption and lignin removal occurs in this reaction stage. The pulps used in the study were ground in a Wiley mill to promote intimate mixing in the reactor. Duplicate chlorination experiments demonstrated the utility of the reactor system in obtaining reliable data for reaction durations of less than 43 sec. Delignification in the initial phase of chlorination was quite sensitive to the presence of molecular chlorine. Changes in pH or available chlorine concentration which increased the concentration of molecular chlorine promoted delignification and yielded higher levels of organically bound chlorine in the pulp meals. A definite relationship between delignification and the extent of bound chlorine was observed for all reaction conditions. Oxidative consumption of chlorine contributed to lignin removal to an extent dependent upon the temperature and concentration of molecular chlorine. A maximum of about 1 g of chlorine was consumed per gram of lignin removed. Cellulose degradation, as indicated by pulp viscosity, was slight except at low reaction ph where acid attack also contributed to the overall viscosity loss. Many of the observations made during the short reaction periods used in this study were similar to results of previous studies of pulp chlorinations which proceeded from several minutes to several hours. (Author abstract modified)

13605

Meller, Alexander and Erik L. Ritman

RETENTION OF POLYSACCHARIDES IN KRAFT PULPING. II. THE EFFECT OF BOROHYDRIDE ADDITION TO KRAFT LIQUOR ON PULP YIELD, CHEMICAL CHARACTERISTICS AND PAPERMAKING PROPERTIES OF PINUS RADIATA PULPS. TAPPI, 47(1):55-64, Jan. 1964. 22 Refs.

The yield and chemical characteristics of kraft and borohydride- kraft pulps are compared. The addition of sodium borohydride to kraft liquors is found to increase the yield 5-6% by rendering polysaccharides resistant to the endwise type of alkaline degradation and by maintaining higher alkalinity throughout the cooking. Analytical data reveal that borohydride-kraft pulps have much lower pentosan content, lower permanganate number, much higher hexosan content, slightly lower alpha-cellulose content, and considerably lower alpha-pentosan content than the kraft pulps prepared under identical cooking conditions. Borohydride-kraft pulps beat faster to a given freeness than kraft pulps, but, at the same weight and bulk, the strength properties of the handsheets prepared from the former are inferior. If tearing strength and breaking length of the sheets are corrected for yield differences, the strength differences tend to disappear, particularly with well-beaten pulps. Calculations based on rate data show that the decomposition of sodium borohydride added to the kraft liquor is practically complete when the temperature of 130 to 140 C is reached in pulping Pinus radiata wood under conditions used in the investigation. (Authors' abstract modified)

13606

Kleinert, T. N. and L. M. Marraccini

VAPOR-PHASE KRAFT COOKING OF BLACK SPRUCE - DELIGNIFICATION AND PULP STRENGTH PROPERTIES. (Part III of a series of ALKALINE PULPING STUDIES.) TAPPI, 48(4):214,223, April 1965. 32 refs.

The conditions under which short cycle kraft cooking (20 min or les of commercial spruce chips will produce bleachable grades of pulp were studied. The influence of such variables as concentratio of the impregnation liquor (effective alkali charge), temperature and time of pressure impregnation, and temperature and duration of the steam cooking of the impregnated chips on pulp properties was considered. Provided the alkali charge was sufficient, increasing the impregnation temperature to 150 C reduced rejects and pulp lignin content, and also improved brightness. However, at 150 C, viscosity and strength properties tended to decrease. Above 150 C, and adverse effect on delignification was noted. Cooking to the same degree of delignification was studied between 180 and 190 C by shortening time according to the H-factor relationship and using three liquor concentrations (42.0, 52.5, and 63.3 g/liter) in chip impregnation. With the exception of folding endurance, temperature increase did not markedly affect pulp strength properties, but concentrations higher than 50 g/L lowered most strength properties. This effect is related to unconsumed effective alkali. When cooking to low rejects at screened yields of 45 to 53%, yield had no influence on pulp strength properties. At a screened yield of about 47% or less, and a pulp lignin content less than 6%, beating time at each freeness level investigated was constant. In contrast, at higher yields beating time increased with increasing yield and lignin content. Time of steam prehydrolysis at 170, and 185 C varied between 10 and 20 min, and vapor-phase cooking at 182.5 and 185 C between 15 and 20 min. Pulps low in lignin and pentosan, with good strength properties, were obtained. (Authors' abstract modified)

13608

Kleinert, T. N. and L. M. Marraccini

DISTRIBUTION OF CHEMICALS IN COMMERCIAL WOOD CHIPS. I. ALKALINE PULPING STUDIES. TAPPI, 48(3):165-170, March 1965. 31 refs.

Various factors which influence penetration and distribution of kraft cooking chemicals in commercial sprucewood chips in the impregnation stage have been investigated. Hydrostatic pressure, temperature of the liquor, and liquor-to-wood ratio, together with diffusion phenomena, were major factors in the penetration of alkali into wood and its distribution throughout the wood tissue. These processes take place in an early stage of the treatment. The findings show that uniformity of alkali distribution has a bearing on residual lignin and pulp rejects. In general, under constant conditions of penetration, the amount of alkali taken up by the wood appears to be nearly proportional to the liquor concentration. The alkali is present in and on the wood in three distinct formss: (1) the alkali sorbed on the wood constituents, (2) the alkali dissolved in the liquid phase filling the capillarie and interstices of the wood, and (3) the alkali present in the liquid phase adherent to the chip surface. Surfactants interfere with alkali uptake and the subsequent cooking of softwoods. It is suggested that they are sorbed on wood constituents, occupying locations where the alkali should react during delignification. (Authors' abstract modified)

14134

Nishiyama, Keitaro, Mitsuyosi Nagayasu, and Takeo Azuma

STUDIES ON THE PREVENTION OF PUBLIC NUISANCE BY THE EXHAUST GASES FROM THE KRAFT PULP MILL. PART 4. COMPARISON OF INFLUENCES OF ODOR ON THE INHABITANTS OF TWO DIFFERENT AREAS. (KP seishi kojo haigasu no kogai boshi ni kansuru kenkyu dai 4 ho sogyoreki ga kotonaru ni kojo shuhen jumin no shuki ni taisuru ishiki hikaku). Text in Japanese. Shikoku Igaku Zasshi (Shikoku Acta Medica), 24(1):53-57, Feb. 1968. 2 refs.

The influences of bad odor on inhabitants were studied comparatively in areas adjacent to mills designated the K and N mills. Contrary to belief that interest in bad odor would be more active in an area around a newly-founded factory (K) than around an older one (N), no significant differences were noticed in the complaints of the inhabitants of the two areas. However, in the N area, complaints of respiratory disorders were fewer than in the K area. The influence of the time of day, weather, and wind velocity on the degree of bad odor were similar in both areas. A larger number of people in the N area suffered from the odor throughout the year than those in the K area. Sectional differences of the effect were less in the N area than in the K area. This was probably due to the unstableness of the wind direction in the N area. (Author abstract modified)

14580

Schoening, M. A. and R. H. Wright

INTENSITY OF THE ODOR RELEASE AT VARIOUS POINTS IN THE KRAFT PULPING PROCESS. TAPPI, 35(12):564-569, Dec. 1952. 6 refs.

The concentration of hydrogen sulfide and methyl mercaptans in various plant effluents were surveyed in a study of the problem of odor reduction in kraft processing. Speicies of wood cooked were western hemlock, Douglas-fir, and red cedar; each was cooked separately and the concentration of malodorous gas measured at the following points: digester relief and gas-off, blow gases, evaporator effluents, furnace gases, stack gases, green liquor tank vapors, and sewer outfall. Results indicated that a higher concentration of mercaptan, on occasion 100,000 micrograms per liter, is given off in the noncondensable gas from a fir cook than from a hemlock cook, a fact that may be due to the turpentine formed from fir. Blow tank vapors were clearly the major source of odor since no attempt was made to condense the stream in the digester discharge. The use of raw sulfur produced a two to threefold increase in the mercaptan concentration in noncondensable gases. Though the total volume of condensable and uncondensable gases released from the blow tank could not be measured, rough calculatio suggest that the loss of sulfur may have exceeded 20 lb per cook. Stack gases carried about one third as much odorous material as the noncondensable blow gases and at a much lower concentration. Neither furnace gases nor evaporator effluents constituted a high intensity source of odor.

15517

Public Health Service, Washington, D. C., National Air Pollution Control Administration

CONTROL TECHNIQUES FOR SULFUR OXIDE AIR POLLUTANTS. NAPCA Publ. AP-52, 122p., Jan. 1969. 274 refs.

About 75% of sulfur oxide emissions in 1966 resulted from the combustion of sulfur-bearing fuels, with coal combustion accounting for the largest part. The economic and technical aspects of various techniques for controlling these emissions are examined in detail; they are categorized as (1) change-over to fuels with lower sulfur content or to another energy source, such as hydroelectric or nuclear power; (2) desulfurization of coal or residual fuel oil; (3) removal of sulfur oxides from flue gas by various processes, including limestone-dolomite injection and alkalized alumina sorption; and (4) increase in combustion efficiency. Of the industrial sources of SO_2 emissions, nonferrous primary smelting of sulfide-containing metallic ores such as copper, zinc, and lead is the largest emitter. About half of the primary smelters in the U. S. now use sulfuric acid recovery to reduce emissions and at the same time offset smelter operating costs. Smelters, oil refineries, pulp and paper mills, steel plants, sulfuric acid plants, waste disposal processes, and a number of other industrial sources are considered in terms of present technology for reducing emissions. The costs of dispersion of sulfur oxides by tall stacks are briefly discussed as an approach toward reducing the frequency of high concentrations at ground level in some areas, and an extensive bibliography on gas dispersion is included. An appendix on chemical coal processing describes the current state of development of such methods as gasification and liquefaction for reducing the sulfur content of high-sulfur coal.

16494

Akamatsu, Isao, Hiroshi Kamishima, and Yutaka Kimura

DEODORIZATION OF EXHAUST GAS IN KRAFT PULPING. (PART I). ON THE FORMATION OF MALODOROUS COMPONENTS IN KRAFT PULPING. (Kurafuto- parupu seizo kotei haishutsu gasu no mushuka (1 ho): Jokai-chu ni okeru akushu-seibun no seisei ni tsuite). Text in Japanese. Kami-pa Gikyoshi (J. Japan Tech. Assoc. Pulp Paper Ind.), 22(8): 406-410, Aug. 1968. 3 refs.

The formation of malodorous substances, methy mercaptan (MMA) and dimethyl sulfide (DMS), in the process of kraft pulping was studied in two types of Japanese pulp woods: softwoods (red pine, cedar and Japanese cypress) and hardwoods (beech, poplar, cherry and pasania oak). Alkaline (Na_2O) and sodium sulfide (NaS) were added to a 400 g dried pulpwood block in an electric autoclave and boiled for 5-1/2 hours at 185 C. Then 5 cc of exhaust gas (raw blow gas) was sent into the cyclone-separator (a cylinder with the diameter of 3 cm and the length of 18 cm) and analyzed for malodorous substances (MMA and DMS) by the use of Yanagimoto GCG-5DH type gas chromatograph. Larger amounts of MMA and DMS, especially MMA, were produced by pulping hardwoods than by pulping softwoods. In pulping the same wood type, the amount of malodorous substances was increased with the increase of cooking hour and temperature, and the concentration of NaS. The white lauan produced the same malodorous substances in quality and quantity as obtained in the pulping of Japanese hardwoods. When the pulping was performed by a batch system, the concentration of DMS was decreased to trace with the depression of pressure in the autoclave.

17198

Endo, Ryosaka

RESEARCH ON THE SOURCE OF ODOR DEVELOPMENT AND THE RESIDENTIAL REACTION IN HOKKAIDO. (Hokkaido ni okeru akushu no hasseigen to jumin hanno). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(4):209-220, April 15, 1968. 23 refs.

The results of an empirical field survey of odor sources are presented. Residents of Hokkaido were sent olfactory test questionnaires and asked to identify the source of an odor, its degree, and its variation with time and season. The residents lived in an area of fish processing plants, oil and fat works, excrement-disposal facilities, paper mills, crematories, incineration plants, refuse dumping sites, and fox-breeding kennels. The returns, which amounted to 1,023,348 identifications of an odor source, were centered on fish- processing plants. This means that they are the major source of an odor problem affecting an estimated 218,300 persons. Next in order of importance were paper factories, incineration plants, agricultural processing plants, and animal breeding buildings. Of the fish-processing plants, the most offensive and noxious odor was produced by fertilizer made from fish flesh, fish oil, and other fish refuse. The major odors were generated in gas emissions from boiling and drying operations. Following the olfaction survey, the quantitative odor measurements and chemical analysis of odor components were undertaken in fishery fertilizer-processing plants. Volatile organic acid was observed to occupy the greatest proportion of offensive odors of fish fertilizers followed by ammonia, amines, mercaptans, and sulfurous acid.

17243

KUSUMOTI, MASAYASU

SOME PROBLEMS IN REFUSE DISPOSAL. (Haibutsu shobun no mondaiten). Text in Japanese. Yosui to Haisui (J. Water Waste), 11(8):619-621, Aug. 1, 1969.

Disposal of refuse, solid or liquid, does not imply complete solution of the refuse problem, although some refuse is partly reduced to energy by incineration and partly dispersed to the atmosphere in an aerosol state. Human productive activities are closely linked to the metobolic processes by which nature provides raw materials and other substances for comsumption, and as long as men remain within the metabolic cycle the balance between nature and productive activities is maintained. In highly industrialized societies, this equilibrium is lost. For example, in the process of pulp manufacturing, nearly 4 tons of refuse is processed per 1 ton pulp, while in the second process of paper production, 13% of refuse is produced per total amount of pulp. What is finally collected as paper is about 40%; the remaining 60% is refuse. The concept of refuse disposal as a transitional process in which refuse is conveyed to the cycle of metabolism and then returned to nature may not be a reliable one. It appears more promising to dump refuse in the ocean or to utilize it for land reclamation by composting or fertilization even though these solutions involve problems of large scale collection and transportation. Studies bearing on technical aspects of composting and land reclamation are sufficiently developed to suggest that composting is the most practical countermeasure for refuse disposal.

17603

Miner, Sydney

PRELIMINARY AIR POLLUTION SURVEY OF HYDROGEN SULFIDE. A LITERATURE REVIEW. Litton Systems, Inc., Silver Spring, Md., Environmental Systems Div., Contract PH

22-68-25, NAPCA Pub. APTD 69-37, 91p., Oct. 1969. 148 refs. CFSTI: PB 188068

The literature on effects, sources, abatement, economics, and methods of analysis of atmospheric hydrogen sulfide is reviewed, with an appendix of tabular material from selected references. Hydrogen sulfide gas is very toxic to humans and at concentrations over 1,000,000 micrograms/cu m, quickly causes death by paralysis of the respiratory tract. At lower concentrations, it has an obnoxious odor and causes conjunctivitis with reddening and lachrymal secretion, respiratory tract irritation, pulmonary edema, damage to heart muscle, psychic changes, disturbed equilibrium, nerve paralysis, spasms, unconsciousness, and circulatory collapse. It also tarnishes silver and copper and combines with heavy metals in paints to discolor or darken the paint surface. The primary natural sources of H2S is biological decay of protein material in stagnant water. Among the many industrial sources are kraft paper mills, oil refineries, natural gas plants, and chemical plants, as well as sewage and sewage disposal plants. Average concentrations of H2S in urban atmospheres range from 1-92 micrograms/cu m. Emissions can be controlled by black liquor oxidation systems, scrubbers, and incineration devices. Hydrogen sulfide corrosion of silver has required substitution of gold contacts in electrical appliances at an estimated increased cost of $14.8 million during 1963. Abatement of air pollution from the pulp and paper industry, in which H2S is a major factor, has cost approximately $10 million per year and is predicted to increase. Major expenditures have been made by refineries and natural gas plants to remove H2S from sour gases and to recover sulfur as a valuable byproduct. Analytical techniques based on the methylene blue and molybdenum blue methods are available for laboratory analysis of H2S. The spot method, based on tiles or paper impregnated with lead acetate, is also widely used. (Author abstrac modified)

17633

Kikuchi, Itaru, Shinsaku Sato, Hiroshi Funaki, and Hikaru Sone

OFFENSIVE ODORS. 12. AIR POLLUTANTS GENERATED AT KP PLANTS. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 2p.

Measuring operations were conducted at several kraft pulping plants to determine the source of pollutants, especially the offensive odors. Measurements were made of the exhaust gases from the heavy oil boilers, the recovery boiler, and the turpentine condenser. The JIS method was used to measure sulfur oxides, and the MB method for hydrogen sulfide. With respect to offensive odors, efforts were concentrated on the measurement of volatile organic sulfur compounds, such as methylmercaptan and methylsulfide; for this purpose, gas chromatography was used. The results showed that the sulfur oxides were within the prefectural limit for public hazards. It was confirmed, however, that an excessive amount of fine dust is generated from the recovery boilers and bark boilers. Also, H2S amounting to 60 ppm was detected from the recovery boilers. Substantial amounts of methylmercaptan and methylsulfide were detected from the turpentine condensers and from the recovery boilers. These compounds were identified and quantitatively determined. Some peaks not yet identified were also obtained in the gas chromatograms.

18164

Snyder, Joe W.

MEASURING BLEACHING TOWER RETENTION TIMES. Tappi, 49(12): 105A-106A, Dec. 1966.

Fluorescent dye-treated pulp nodules added to pulp entering the bleaching towers were used to determine the flow and retention pattern in kraft mill chlorination, caustic extraction, hypochlorite, and chlorine dioxide cells. This was accomplished by observation made through a manhole in the top of the chlorination tower. All luminous particles were counted during one minute intervals, and the time and date of the test, pulp flow rate, and consistency were recorded. A graph of retention time in minutes plotted against percentage of luminous particles was prepared. The shape of the frequency curve, as well as its position with respect to theoretical retention time, provided evidence of the flow pattern.

18182

Clement, J. L., J. H. Coulter, and S. Suda

B AND W KRAFT RECOVERY UNIT PERFORMANCE CALCULATIONS. Tappi, 46(2):153A-160A, Feb. 1963.

Calculations used commercially to determine a material and heat balance for a kraft recovery unit are described. The application of recovery-unit design in the calculation procedure which is based on elemental liquor analysis, permits accurate prediction of unit performance. A material and heat balance can be calculated from elemental analysis for all pulp-mill recovery systems. The procedure described is particularly valuable in calculating the expected thermal performance of recovery units processing sodium- base liquors differing in properties from kraft liquor. An example is a unit burning neutral sulfite semichemical liquor to produce a high-sulfidity smelt with low reduction relative to kraft. The procedure is applicable to the design of recovery units processing magnesium, calcium, and ammonium-base liquors. This has been done successfully in predicting the performance of magnesium-base recovery units by analyzing the calorimeter bomb products of liquor combustion to permit calculating a heat-of-reaction correction.

18188

Lewis, E. C., and R. G. Tallent

CHEMICAL RECOVERY UNIT. (Combustion Engineering, Inc., Windsor, Conn.) U. S. Pat. 3,304,918. 5p., Feb. 21, 1967. 3 refs. (Appl. Dec. 29, 1965, 2 claims.)

A new chemical recovery unit for employment in the kraft pulping process is described. The unit consists of an upright furnace into which black residual liquor is introduced for burning and smelting. The furnace has an inner surface lined with tubes designed to generate steam of at least 900 psi. The inner surface also has primary air induction ports spaced above the furnace bottom for directing air inward toward the combustibles on the bottom of the furnace. Smooth metal tubes are welded to the steam generating tubes for the purpose of securing a layer of molten chemicals. During the operation of the chemical recovery unit, molten chemicals are collected at the bottom of the furnace and are periodically withdrawn through a suitable spout.

18189

Gauvin, W. H., and J. J. O. Gravel

CHEMICAL RECOVERY FROM SULFITE SPENT LIQUORS BY THE ATOMIZED SUSPENSION TECHNIQUE. Tappi, 43(8):678-683, Aug. 1960. 9 refs.

The pyrolysis of neutral sulfite semichemical (NSSC) spent liquors under reducing conditions yields a solid product consisting essentially of sodium carbonate with small amounts (usually less than the originally present in the liquor) of sodium sulfate. Preliminary studies have indicated that sodium carbonate can be recovered with yields of 90% and better. Combustible gases are produced of good calorific value from which the sulfur can be recovered as SO2. In this report the engineering aspects of this technique are presented. A corrosion study has shown that austenitic stainless steels are strongly attacked by fused sodium carbonate, and experimental data is presented both above and below the fusion temperature (765 C) and for a wide range of residence times. Reactor pressures of up to 60 psi are used for feed concentrations of 55%, and the results indicate that adequate sodium carbonate conversions can be obtained at wall temperatures below the fusion point. (Author's abstract modified)

19899

Sawaya, Tsugio

SURVEY ON THE PUBLIC NUISANCE BY OFFENSIVE ODOR. (Akushu kogai gairon). Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 8(2):34-46, June 1970. 12 refs.

Offensive odor as a public nuisance can be classified according to its composition in the following industrial sources: hydrocarbons and mercaptan from petroleum refining; organic sulfur compounds such as mercaptan from paper and pulp factories; and amine and fatty acids from fish meal and rendering factories and stockyards. Odors of each category are explained. While it is well established that olfactory reception is caused by a stimulus given to nerves by gaseous substances or air-borne particulates, the mechanism of the stimulus is not yet known. Odors of industrial waste water are classified into the following, that is, aromatic, free chlorine, disagreeable, earthy, fishy, grassy, moldy, musty, peaty, sweet, free hydrogen sulfide, and vegetable. Weber-Fechner's law, fatique, personal differences, and interference of odors are described. Definitions of threshold and odor concentration are provided. Measuring methods of odor include dilution by air, equilibrium with salt water, and a method used by processing factories to monitor the total amount of odor substances. Physical or chemical methods are available for odor abatement. Scrubbers, condensation by cooling, adsorption by active carbon, and dilution by air are in the physical category, while chemical methods include processing by acid, alkali, chlorine, or ozone, ion exchange, masking, recombustion, and catalytic combustion.

20553

Sullivan, Ralph J.

PRELIMINARY AIR POLLUTION SURVEY OF ODOROUS COMPOUNDS. A LITERATURE REVIEW. Litton Systems, Inc., Silver Spring, Md., Environmental Systems Div., Contract PH 22-68-25, NAPCA Pub. APTP 66-42, 244p., Oct. 1969. 443 refs. CFSTI: PB 188089

Odors may cause mental and physiological effects in humans, such as nausea, headache, loss of sleep, loss of appetite, impaired breathing, and in some cases allergic reactions. Community and personal pride and status may be adversely affected. No information on the effect of odorous air pollutants on the health or behavior of domestic, commercial, or experimental animals was found in the literature. The petroleum industry, petrochemical plant complexes, chemical industry, pulp and paper mills, coke ovens, coal, iron-steel industry and foundries, food processing, meat industry (including livestock slaughtering, inedible rendering of animal matter, fish processing, tanneries, etc), combustion processes (including diesel engines), and sewage are listed as sources of odors. The literature contains no quantitative data on the odor concentration in ambient air. Surveys have been made, but they show only the detective disagreeable odors and not their intensity. Abatement methods fall into several categories: combustion, absorption, adsorption, odor masking, odor removal, chemical control, biological control, and containment. Combustion is generally accepted as the best way to deodorize malodorous gases. Oxidation at 1,200 F or above usually gives satisfactory results. Economically, odor pollution depresses property values. The human nose is the only reliable detector, and several laboratory and field methods (organoleptic methods, such as the vapor dilution technique and the syringe dilution techinque) and instrumental methods (such as gas chromatography) have been deveolped to quantify human observations.

21385

Hendrickson, E. R., J. E. Roberson, and J. B. Koogler

CONTROL OF ATMOSPHERIC EMISSIONS IN THE WOOD PULPING INDUSTRY. (VOLUME 1). (FINAL REPORT). Environmental Engineering, Inc., Gainesville, Fla. and Sirrine (J. E.) Co., Greenville, S. C., NAPCA Contract CPA 22-69-18, 193p., March 15, 1970. 35 refs. CFSTI: PB 190351

A study was conducted to make a comprehensive and systematic evaluation of the technical and economical problems involved in the control of airborne emissions, especially particulate and gaseous sulfur compounds from the chemical wood pulping industry. The economic position and present geographic distribution of the chemical wood pulping industry are discussed. The major variations in the kraft, sulfite, and semichemical pulping processes are described. Kraft gaseous emissions include hydrogen sulfide, sulfur dioxide, methyl mercaptan, and dimethyl sulfide. They are emitted by the recovery furnace, the lime kiln, evaporators, stock washers, smelt dissolving tank, and other sources. Particulate emissions from the kraft process come mainly from the recovery furnace, the lime kiln, and the smelt dissolving tank. Emissions from the sulfite and semichemical processes are also discribed, along with a review of emissions standards.

21728

Hendrickson, E. R., J. E. Roberson, and J. B. Koogler

CONTROL OF ATMOSPHERIC EMISSIONS IN THE WOOD PULPING INDUSTRY. VOLUME 2. (FINAL REPORT). Environmental Engineering. Inc., Gainesville, Fla., and Sirrine (J. E.) Co., Greensville, S. C., Contract CPA 22-69-18, 266p., March 15, 1970. 45 refs. CFSTI: PB 190352

Chapters 5 through 8 are contained in this second of three volumes of a study of control of wood pulping emissions. Chapter 5 reviews methods currently in use for particulate and gaseous control. Evaluation of each method includes a cost and effectiveness study, as well as discussion of engineering factors unique to specific applications. New methods, which have had limited or no application within the U. S. but which may show promise for future use, are described in Chapter 6. Order of magnitude costs are developed for comparison purposes. In Chapter 7, overall control technology is critically discussed, with the relative merits and specific limitations of the most effective and economical methods summarized. An example of selected kraft process configurations to meet selected emission limitations is analyzed. Evaluation parameters are applicable emission sources, efficiency, flexibility, economics, reliability, and adaptability. Chapter 8 discussed processes for flue gas desulfurization and possible recycling of the sulfur in the pulping process. It is concluded that none of the processes reviewed are feasible for application in the foreseeable future.

22148

Kikuchi, T., H. Funaki, S. Sato, and K. Saito

ODOROUS SOURCES IN KRAFT PULP MILLS. (KP kohjoh chu no akooshu hasseigen ni tsooite). Text in Japanese. Taiki osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):149, 1969. (Proceedings of The Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

In a pulp mill in Miyagi Prefecture which manufactures bleached kraft pulp at 430 ton per day, malodorous substances, mainly volatile organic compounds, are analyzed qualitatively and quantitatively by means of gas chromatography after collecting and concentrating samples by acetone at a temperature of -78 C at several points in the process. At a recovery furnace of the recovery process, methyl mercaptan (1.22 to 4.04 ppm), dimethyl sulfide (0.84 to 1.80 ppm) and hydrogen sulfide (236 to 346 ppm) are detected. In the digestion process, dimethyl sulfide (263 to 280 ppm) in the exhaust exit of a blow tank and methyl mercaptan (11,560 to 14,125 ppm) and dimethyl sulfide (9880 to 14,100 ppm) in exhaust exit of the 'tarpentin' tank are found. From this analysis, the gases from the latter process seem to pollute the air around the mill.

24398

Claiborne, J. T., Jr.

NO RECONVERSION PROBLEMS FOR SULPHUR. Mining Congr. J., 32(2):67- 69, Feb. 1946.

In order to meet war needs, the country's sulfuric acid production capacity jumped more than 2,000,000 short tons to a total of 10,500,000 short tons, 100% acid. However, undue expansion of the industry was avoided by a well organized system of salvage and reuse of the acid first employed in explosives plants. Outstanding among peactime sulfur consumers was the fertilizer industry. The insecticide and fungicide industries also played a part with the fertilizer industry in building up American food stocks. One of the big sulfur consumers, the pulp and paper industry annually took more than 10% of the total sulfur production, while an interesting new use for sulfur in the paper industry appeared to lie in the new bisulfite process for counteracting stream pollution. In the rubbe industry, sulfur continues to play a variety of roles, whether in the vulcanization of both the natural and synthetic products, or as sulfuric acid. Sulfuric acid is one of the requisite ingredient for the production of high octane gasoline, while the steel industr continues to be an important user of sulfuric acid for pickling purposes. Announcements from the chemical industry for 1946 stressed research in many hither-to untouched fields, pointing out markets for war developed plastics, synthetic fibers, and other chemical raw materials.

24903

Wright, R. H.

IS IT POSSIBLE TO BUILD AND OPERATE A COMPLETELY ODORLESS KRAFT MILL? Can. Pulp Paper Ind. (Vancouver), 10(9):21-22, 24, 26, 28, 30, 32, 34, Sept. 1957.

It is possbile to build a completely odorless kraft mill if management is willing to pay the price. The initial down payment would pay for odor control equipment; the direct installment payments are the costs of maintaining all the odor control equipment at top efficiency; indirect installment charges occur whenever it is necessary to limit production to prevent odor emission. Most kraft odors are due to organic sulfur compounds such as methyl mercaptan and its oxidation products. The kraft operation also emits particulate matter, mostly compounds of sodium. The sources of emissions are discussed, and control measures are described. Dusts are usually removed by a combination of scrubbers, bag filters, or electrostatic precipitators. The process of black liquor oxidation is discussed. When it is properly oxidized, the release of odors from black liquor is greatly curtailed. Research in the areas of contaminant identification and quantification is necessary in order to get a better understanding of effective design characteristics.

25205

Martin-Lof, Rutger

HOW THE SWEDISH PULP AND PAPER INDUSTRY COMBATS AIR POLLUTION. Preprint, International Union of Air Pollution Prevention Associations, 42p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-28G.)

The sulfite pulp industry is responsible for more than half of the air pollution from the pulp industry in spite of the fact that the sulfite pulp production only amounts to about 29% of the total chemical pulp production. This is due to the fact that in the calcium sulfite process, at present the dominating sulfite process in Sweden, no method for chemical recovery is available. The production of sulfate pulp, sulfite pulp on a so called soluble base, and semichemical pulp is expected to increase and to be concentrated to a few large units, while the production of calcium sulfite pulp, is expected to cease in the long run. Dust emission emanates from soda recovery boilers, lime kilns, lye furnaces, and bark furnaces. Electrostatic filters are used at all Swedish sulfate mills for purification of the flue gases from the recovery boilers and at more than half of the mills there are scrubbers for washing of the gases as well. Flue gases from lime kilns are usually cleaned in a venturi gas scrubber. Dust separation from lye and bark furnaces are usually performed in cyclone type mechanical equipment. The emission of acidic gases consists of sulfur dioxide and some sulfur trioxide, and emanates mainly from the lye furnace for burning of the sulfite waste liquors and from the recovery boilers in the sulfate mills. As distinguished from the calcium-based sulfite process, the other pulping processes involve chemical recovery processes and the emissions are due to inevitable losses in the recovery processes. The emission of odorous substances on a large scale occurs in connection with the sulfate process only. In order to collect the odorous gases a pipeline can be set up through the sulfate mill. As a consequence of The Environmental Preservation Act, which came into force in Sweden on July 1, 1969, the nature conservation authorities and the pulp and paper industry have in close collaboration carried out a very comprehensive investigation comprising the charting of existing emissions and an examination of the technical and economic possibilities of lowering these emissions. On the basis of these investigations, The National (Swedish) Environment Protection Board has issued recommendations for restriction of emissions at air polluting establishments. The investments in water and air preservation measures are expected to amount to about 10% of the total investments in the pulp industry. (Author abstract)

25683

Statens Naturvardsverk, Solna (Sweden)

AIR POLLUTION PROBLEMS IN THE WOOD PRODUCTS INDUSTRY. (Skogsindustrins luftvardsproblem). Text in Swedish. Solna (Sweden), Statens Naturvardsverk, 1969, 246p.

The role of air pollution is discussed with reference to the variou mechanical, chemical, and semichemical processes involved in the making of wood pulp and wood pulp products such as paper and cellulose. Most attention is given to the sulfate and sulfite chemical processes, with production charts on which are indicated the points at which emissions are most critical. The major pollutants given off by these processes are discussed, with special emphasis on particulate matter, SO2, and chlorine compounds. A final chapter deals with acceptable emission levels and levels of pollution in the vicinity of pulp plants. Swedish standards for emission and pollution levels are compared with those of other countries, and figures are given for the pollution levels in the immediate vicinity of Swedish pulp mills. A series of appendices give data on such subjects as the costs of installation for certain types of dust separators, the elimination of H2S and other unpleasant odors, and the economic consequences of a transition from a calcium to a magnesium base in plants using a sulfite process. The limits set on atmospheric SO2 content in Sweden are a monthly average of 0.05 ppm, a 24-hour average of 0.1, and a maximum (in any 30-minute period) of 0.25 ppm. The Public Health Institute in Stockholm has set limits for the following organic sulfur compounds: H2S, .00069 mg per cubic meter; methyl mercaptan .0041 mg; and dimethyl monosulfide, .002 mg.

26255

Osterli, Victor P.

AIR POLLUTION CAUSED BY AGRICULTURE, FORESTRY AND THE FOREST PRODUCTS INDUSTRIES: COMBUSTION. In: Project Clean Air. California Univ., Berkeley, Task Force 5, Vol. 1, Section 4, 19p., Sept. 1, 1970. 51 refs.

To suddenly eliminate agricultural, forest land, and wood residue burning because it is a socially undesirable practice related to air pollution will necessitate development of satisfactory, economical, and practical alternatives. In some instances, burning has also destroyed disease, insect, and weed pests. The average daily contribution of air pollutants from agricultural burning throughout California is less than 56 tons of hydrocarbons per day, but the concentration of the pollution at certain times of the year, in certain localities, and during periods of poor ventilation presents a problem. Agriculture in som county air pollution control districts permits burning only when the inversion base and the maximum mixing height are at prescribed levels and specified wind velocities occur. Problems of controlled burning must be considered in the light of the benefits of open areas created within brush fields by the range improvement program. This involves the use of fire for the removal of 'less desirable' woody vegetation followed by reseeding with forage species to provide more feed of better quality for cattle. Alternative methods of disposal are especially needed for the burning of residual waste from sawmills and wood processing mills. The incorporation of residues into the soil by farm operations should b encouraged, while shredding followed by discing is useful for the disposal of logging wastes. Herbicides have to a large extent replaced open burning along ditchbanks, roadsides, and around farm headquarter. In the instance of wood residuals, they are finding increased utilization by their conversion to chips to be used to wood pulping and particle board manufacturing. Pest problems, economic factors, and the search for alternatives are discussed. Short-term and long-term research needs are mentioned, as well as research in forest waste management.

26441

Oglesby, Sabert, Jr. and Grady B. Nichols

A MANUAL OF ELECTROSTATIC PRECIPITATOR TECHNOLOGY. PART II -- APPLICATION AREAS. Southern Research Inst., Birmingham, Ala., NAPCA Contract CPA 22-69-73, 875p., Aug. 25, 1970. 118 refs. NTIS: PB 196381

The application of electrostatic precipitators is reviewed for the electric utility industry, the pulp and paper industry, the iron and steel industry, the rock products industry, the chemical industry, in cleaning municipal incinerator dusts, for the petroleum industry, and in the nonferrous metals industry. Particular emphasis is placed on the dust and gaseous emissions of the processes discussed. This is followed by a tabulation of input and design parameters for precipitators operating on various types of dust control problems and an analysis of critical design parameters and test results. Cost data are also presented. The electrolytic reduction of aluminum, the production of copper, primary lead, and zinc reduction are discussed in the area of the nonferrous metals industry. In the petroleum industry, catalytic cracking and detarring are indicated as application areas. Refuse properties are discussed, as well as types of incinerators. Sulfuric acid production, the production of elemental phosphorus, phosphoric acid, and carbon black, warrant the use of precipitators in the chemical industry. In the rock products industry, the manufacture of Portland cement and the gypsum industry present problems. Coke ovens, sinter plants, blast furnaces, open hearth furnaces, basic oxygen converters, electric arc furnaces, scarfing machines, and iron cupolas are areas of application in the iron and steel industry. In the pulp and paper industry, precipitators are indicated for the recovery of boiler particulate emissions and sulfate process flue gases. Fly ash precipitators are needed in the electric utility industry.

26594

Adam, Robert

WATER AND AIR POLLUTION CONTROL IN THE UNITED STATES. (Wasser- und Luftverunreinigung in den USA). Text in German. Wasser Luft Betrieb, 14(12):499-500, 1970.

The extent of the air and water pollution problem in the U.S.A. is demonstrated on statistical data pertaining to agricultural waste, mining industry waste, sewage volume, emissions from automobile exhausts, power plants and other industrial sources, abandoned cars and solid waste, and sums contributed by the Federal Government to the states to deal with these problems in 1969 and 1970. Water pollution stems from communal sewage, from industrial effluents, and from agriculture; the latter is the biggest polluter as a result of the effect of fertilizers, insecticides, and pesticides. About 60% of the air pollution stems from internal combustion engines, the balance from industrial and domestic heating sources. The stimpulations of the Clean Air Act of 1967 and their implications for the automobile industry, the metal working industry, the paper industry, sawmills, power plants, the coal mining industry, the housing industry, and solid waste removal are discussed.

26979

Agardy, Franklin J.

INDUSTRIAL AIR POLLUTION CONTROL ENGINEERING. Preprint, 28p., 1970 1 ref. (Presented at the Hawaii Air Pollution Seminar, Kahala, Oct. 30-31, 1970.)

Air pollution control features of a pulp and paper mill to be located in a sparsely populated area of a western state are presented. A systematic investigation of the proposed mill included the following tasks: review of all plant processing operations and identification of significant sources of air pollution; consideration of local meteorology; review of pertinent existing and potential future air pollution regulatory requirements delineation of appropriate methods for elimination, reduction, or masking of air pollution problems with consideration for process modifications as well as pollution control devices; establishment of a priority list of items calling for action at the plant; selection of alternate air pollution control systems and estimation of efficiency and total cost information for each system; and development of an efficient monitoring scheme. The proposed pulp and paper mill will have a design capacity of approximately 360 tons per day and use a labor force in excess of 700 men. Plant statistics are summarized, as well as the major operations included in the kraft type of process. Emissions from several different units are enumerated. During the preliminary design of the mill, it was recognized that the state in which the proposed mill was to be located did not have very effective air pollution regulations. Therefore, it was decided to design air pollution systems based on the Oregon standards, which were considered to be the most severe as regards pulp and paper mills. Standards are reviewed, and the pollution control techniques are discussed.

27293

Winthrop, S. O.

AN OVERVIEW ON AIR POLLUTION. Chem. in Can., 23(2):21-25, Feb. 1971.

In 1966, the five air pollutants accounting for 98% of all emissions in the U. S. were carbon monoxide (52%), sulfur oxides (18%), hydrocarbons (12%), particulates (10%), and nitrogen oxides (6%). By far the greatest source of the pollutants is the combustion of fossil fuels. Other important sources are industrial activities such as iron and steel manufacturing, metal smelting, oil refining, pulp and paper, chemical, and petrochemical operations. The adverse health effects associated with air pollutants are noted, as are their effects on vegetation and their possible effects on climate and global ecology. The ultimate control of air pollution will require the application of science and a greatly increased research and development effort by governments, universities, and industries.

27433

Blosser, Russell O., Andre L. Caron, and Leon Duncan

AN INVENTORY OF MISCELLANEOUS SOURCES OF REDUCED SULFUR EMISSIONS FROM THE KRAFT PULPING PROCESS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1970. 2 refs. (Presented at the Air Pollution Control Association Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-75.)

Details are given of a special field study now in progress to determine the composition, magnitude, and factors affecting the discharge level of miscellaneous source emissions for a sample representing about 20% of the U. S. kraft industry. These miscellaneous sources include the lime kiln, brown stock washer ventilation system exhausts, brown stock seal tank and vacuum system exhaust vents, black liquor oxidation system exhaust vents, and smelt tank vents. The study is using two specially-designed mobile laboratories equipped with total sulfur analyzers and chromatographs. Process variables that may have some effect on miscellaneous source emissions and which are included in this investigation are residual sulfur content of process materials and combustion conditions in lime kilns.

27501

Vandergrift, A. Eugene, Larry J. Shannon, Eugene E. Sallee, Paul G. Gorman, and William R. Park

PARTICULATE AIR POLLUTION IN THE UNITED STATES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 30p., 1970. 2 refs. (Presented at the Air Pollution Control Association, Annual Meeting 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-148.)

The identity, characterization, and quantity of the national particulate air pollution problem from stationary sources were determined. Particulate emissions from stationary sources were obtained from data on emission factors, grain loadings, and materia balances. The principal method used for establishing the tonnage emitted by an industry utilized uncontrolled emission factors. Total tonnage emitted was calculated from an emission factor for the uncontrolled source, the total tonnage processed per year by the industry, the efficiency of control equipment used, and the percentage of production capacity equipped with control devices. Particulate emission totaled approximately 21 times 10 to the 6th power tons per year. Major stationary sources included electric power generation plants, the forest products industry, agriculture and related operations, the crushed stone industry, the cement industry, and the iron and steel industry. Estimates of the total quantity of particulate pollutants were made up to the year 2000 by taking into account changes in production capacity, improvements in control devices, and legislative or regulatory action to enforce installation of control equipment. Forecasts indicated that particulate emissions can be reduced from 21 times 10 to the 6th power tons per year to 13 times 10 to the 6th power tons per year by 1980 through the installation of currently available control devices on all sources. (Author abstract modified)

27942

Hammar, C. G. B. and H. C. I. Arne

THE SODA FURNACE AS A SOURCE OF AIR POLLUTION. Preprint, Canadian Pulp and Paper Assoc., Technical Section, and Chemical Inst. of Canada, p. 59-60, 1970. (Presented at the Canadian Wood Chemistry Symposium, 3rd, Vancouver, B. C., June 24-26, 1970.)

The principles of a computer method to obtain complete material balances from a relatively closed chemical recovery system in a Swedish kraft pulp mill are briefly outlined. The closed system is necessary because of recent stringent air pollution regulations. In computing soda furnace sulfur losses from such balances, data from a standard sulfate mill and a sodium bisulfite mill are summarized in a linear equation showing the yield of sulfur in the soda smelt as a function of the sulfur to sodium ratio in the feed to the furnace. With equations and data available for each process stage, material balances are made by a trial-and-error method, assuming a preliminary value for the sulfidity of the white liquor and correcting it until the sum of sulfur losses equals the sulfur in the feed. As a demonstration, calculations are given for several modifications of a standard 100,000-ton sulfate mill. To control furnace sulfur losses, studies based on pyrolysis reaction indicate that the highest sulfur retention is obtained if the black liquor is heated slowly in the furnace. Efficient process control can be achieved only by considering the furnace as part of the total sulfate process.

28095

Roberson, James E., E. R. Hendrickson, and W. Gene Tucker

THE NAPCA STUDY OF THE CONTROL OF ATMOSPHERIC EMISSIONS IN THE WOOD PULPING INDUSTRY. TAPPI, 54(2):239-244, Feb. 1971. (Presented a the Technical Association of the Pulp and Paper Industry Engineerin Conference, Denver, Colo., Oct. 25-29, 1970.)

An 18-month system analysis study of the wood pulping industry was undertaken to identify technical and economic problems related to the control of industry emissions and to assess the economic impact of air quality standards on the industry. The study involved the preparation of 17 flow diagrams for the three pulping processes (kraft, sulfite, and NSSC), engineering evaluations for a range of mill sizes for various control methods, and the development of a mathematical model to project investment and operating costs in the kraft pulping industry through 1980. The results are presented in tables of emissions and control costs for a hypothetical existing 500 tons/day mill and the same mill controlled to Oregon-Washington Standards. Based on the latest available data, current installatio and operating costs are also given for the industry. Total installed cost is approximately $166,000,000 for the kraft industry and approximately $900,000 for the sulfite industry. Net annual costs for the kraft industry is about $24,000,000, while in the case of sulfite a slight net return is indicated. The increased expenditures reported are not expected to diminish the projected pulp and paper production of more than double 1968 figures by 1985.

28885

Douglass, Irwin B. and Lawrence Price

SOURCES OF ODOR IN THE KRAFT PROCESS. II. REACTIONS FORMING HYDROGEN SULFIDE IN THE RECOVERY FURNACE. TAPPI, 51(10):465-467, Oct. 1968. 9 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, 52nd, New York, Feb. 19-23, 1967.)

The production of hydrogen sulfide during pyrolysis in the kraft pulping process was studied in the laboratory by heating inorganic substances assumed to be present in the black liquor at 600 C, first with soda lignin and then with glucose. In experiments using sodium sulfate and sodium sulfite, negligible amounts of hydrogen sulfide were formed. In experiments with elemental sulfur, sodium sulfide, and sodium thiosulfate, however, heating with soda lignin or glucose caused 30-75% of the inorganic sulfur to be converted to hydrogen sulfide. These result clearly indicate that large volumes of hydrogen sulfide are formed in a recovery furnace. If conditions for combustion are optimum in the furnace, this hydrogen sulfide will quickly burn to sulfur dioxide and water. The former will react with the alkali in the incoming black liquor and be retained. If the furnace is not operated properly, the hydrogen sulfide can escape to the atmosphere to become a major cause of air pollution. (Author abstract modified)

28898

Wakefield, John W. and Earle P. Bisher

AIR POLLUTION CONTROL AND ITS EFFECTS ON OTHER ENGINEERING ACTIVITIES. Eng. Progr. Univ. Florida Bull. Ser., 10(9):8-10, Se 1956.

Examples are cited to show how the art of air pollution control is apt to produce some water pollution and how water pollution control practices can cause some air pollution problems. For instance, water pollution is increased by treating emissions from the Kraft process or phosphate rock processing in stack washers or electrostatic precipitators, and a sewage treatment plant that treats water with a high sulfate content is a source of odorous hydrogen sulfide, even though the plant is well-designed and well- operated. One way to minimize the effects of air pollution control on water pollution is for industry to operate in a manner that will produce a minimum of pollutants requiring treatment.

28976

Bajusz, Alex J.

HYDROGEN SULFIDE. Pollut. Eng., 3(1):17, Jan.-Feb. 1971.

Hydrogen sulfide is present in most petroleum and natural gas deposits; it is a by-product of petroleum refinery operations; coal-coking operations; and the manufacture of carbon disulfide, viscose rayon, and kraft pulp. The gas is extremely hazardous because of its toxicity and explosive nature; the maximum safe toxic concentration is about 10 ppm while the explosive range of hydrogen sulfide in air is 4.3-45% at an ignition temperature of 250 C. Hydrogen sulfide can be measured continuously with an electrolytic titrator and removed by absorption into an alkaline solution or by wet and dry oxidation methods. The first type of process is used for gas streams containing large amounts of H2S with little or no carbon dioxide. The second group of processes treat gas streams with small amounts of H2S and a high proportion of CO2.

29489

Aaronson, Terri

MERCURY IN THE ENVIRONMENT. Environment, 13(4):16-19, 21-23, May 1971.

Sources of mercury in the environment, levels of mercury contamination, biological and medical aspects of mercury poisoning, and maximum permissible levels of mercury are discussed. In the past, the pulp and paper industry was one of the largest consumers of mercury, which was used to keep slime from forming on the manufacturing equipment. Some chloralkali plants use mercury as a catalyst in the production of chlorine and caustic soda. Agricultural use in both the U. S. and Canada accounts for about 4% of the total mercury used annually in each country. Evidence from studies of mercury content of feathers of fish-eating birds indicates that mercury contamination of water parallels an increase of industrial activity. One of the factors which causes methyl mercury to be held in the body for extended periods is that ingested mercury is excreted in the bile to the intestines, but is almost immediately reabsorbed back into the blood stream, allowing it to further circulate in the body. From studies made in Niigata, Japan, the lowest level of mercury in the blood of a person beginning to show signs of poisoning is 0.2 ppm.

30383

ENVIRONMENTAL PROTECTION PROBLEMS OF THE WOOD PROCESSING INDUSTRY TO BE ANALYZED. (Skegsindustrins miljovardsfragor utreds). Text in Swedish. Tek. Tidskr., 101(1):54-55, Jan. 14, 1971.

During 1970, the wood products industries of Sweden will be collaborating in a project to study known techniques of pollution control and to develop new ones specifically for use by these industries. The project is sponsored jointly by the Society of Swedish Cellulose and Paper Industries and the Wood Industries Foundation for the Study of Water and Air Pollution Control. In earlier times, these industries used larger quantities of fresh water and dumped a much larger quantity of chemicals into Swedish streams. Pollutants, expressed in terms of biochemical oxygen demand, once reached figures as high 250-500 kg BOD5 per ton of pulp produced. The modern use of the recycling of water and chemicals has reduced the output from a sulfate process plant to 25-40 BOD5 per ton, the higher figure applying to processes involving bleaching. In the past 5 years, the wood industries have invested about 250 million kronor (about $50 million) in environmental protection. During the first half of 1970, the investment required in this area will reach the neighborhood of 700 million kronor (about $133 million). Meanwhile, the manufacturing processes themselves are in a state of flux, so that new wood industries can expect to invest as much as 10% of its installation costs in pollution control equipment, while in older plants such provisions grams for the three pulping processes (kraft, sulfite, and NSSC), engineering evaluations for a range of mill sizes for various control methods, and the development of a mathematical model to project investment and operating costs in the kraft pulping industry through 1980. The results are presented in tables of emissions and control costs for a hypothetical existing 500 tons/day mill and the same mill controlled to Oregon-Washington Standards. Based on the latest available data, current installatio and operating costs are also given for the industry. Total installed cost is approximately $166,000,000 for the kraft industry and approximately $900,000 for the sulfite industry. Net annual costs for the kraft industry is about $24,000,000, while in the case of sulfite a slight net return is indicated. The increased expenditures reported are not expected to diminish the projected pulp and paper production of more than double 1968 figures by 1985.

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30701

Weiner, Jack and Lillian Roth

AIR POLLUTION IN THE PULP AND PAPER INDUSTRY. Inst. Paper Chem., Bibliog. Ser., no. 237:1-224, 1969. 769 refs.

A bibliography on air pollution is given limited to problems of the pulp and paper industry. A subject and author index are also included. The bibliography includes control methods, measurement methods, analytical methods, odor counteraction, air quality studies, specific pollutants, and so on.

31327

Witt, J. M. and K. R. Cannon

AIR QUALITY IN OREGON. In: Environmental Quality in Oregon 1971. Oregon State Univ., Corvallis, Environmental Health Sciences Center; Oregon State Government, National Resources, NSF Grant GT-14, p. 3-7, 1971.

The major air pollution problem in Oregon is particulates from smoke. Primary emission from combustion, principally in forest and agricultural residue disposal will probably decrease on the next decade, but other sources which are a function of population will increase. Western Oregon has the highest potential, on a meteorological basis, for an air pollution problem of any area in the continental United States. Low wind movement and frequent inversions are principal factors in restricted natural ventilation. The nature of the persistent haze and increasing visibility loss in western Oregon needs to be studied. The relative contribution of fine particulates from combustion sources, as compared to noncombustion sources including secondary pollutants produced in the atmosphere, should be determined. The major sources of pollution are production of lumber and manufactured wood products, pulp mills, field burning, slash burning, metal processing and use, and motor vehicles. Responsibility for air pollution control in Oregon is divided between three regional agencies and one state agency. Air quality standards were adopted to cover smoke discharge, particulate fallout, and suspended particulate matter. Specific emission standards were adopted for Kraft pulp mills, rendering plants, hot mix asphalt paving plants, wigwam waste burners, and open burning dumps.

31548

Bolker, Henry I.

OUT OF THE WOODS. Tech. Rev., 73(6):22-29, April 1971.

Except for the recycled paper which yields a product for only limited end uses, and the small amount of rags converted into special fine papers, most of the pulp and paper industry's raw material comes from trees. Both the mechanical and chemical methods for rendering wood into pulp are described. The kraft process and the acid-sulfite process are cited. Rendering wood into pulp, and then bleaching and processing the pulp into a suitable base for paper, cause the most serious waste problems in the papermaking process. One of the greatest errors of the paper industry was to use organo-mercury slimicides in its mills to stop the growth of slimy molds on paper machines. The problems with fibers are also mentioned, but every new mill is now being equipped with facilities to remove solid and other wastes before water is returned to the land. Older mills are also acquiring suitable facilities--mainly in the form of large settling tanks where the water can be clarified and secondary aeration systems. Waste materials in true solution constitute a different problem. After separation of the pulp fibers, the spent liquor from a sulfite cook contains lignosulfonic acid, degraded carbohydrate polymers, and free sugars, as well as some residual bisulfite.

32165

Gerstle, Richard W. and Timothy W. Devitt

CHLORINE AND HYDROGEN CHLORIDE EMISSIONS AND THEIR CONTROL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 23p., 1971. 12 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-25.)

Chlorine and hydrogen chloride are emitted to the atmosphere by production processes and by various chemical and metallurgical processes. Hydrogen chloride is also emitted by many combustion processes using coal or fuel oil. The major uses for both chlorine and HCl are in the organic chlorination industry, which consumes almost 7.5 million tons of the chlorine and 0.9 million tons of the HCl. Economical operation of these processes requires the recovery and reuse of both chlorine and HCl whenever possible. Chlorine is emitted mainly from its manufacturing and associated handling and liquefaction processes, and in pulp bleaching. Hydrogen chloride is emitted mainly from coal and refuse combustion processes and, to a much smaller extent, from its manufacture and use. Control techniques for chlorine and HCl are well established for chemical processes and use various types of scrubbers with water or caustic as the absorbing solution. Counter-current packed towers are most commonly used to reduce emissions. The disposal of waste liquor from these scrubbers is a problem when in-plant uses cannot be found. Hydrogen chloride emissions from combustion processes are largely uncontrolled. (Author abstract modified)

32475

Japan Environmental Sanitation Center, Tokyo

REPORT OF SURVEY OF THE SPECIFIED POISONOUS SUBSTANCES AND THE PREVENTION OF OFFENSIVE ODOR. REPORT 4. (Tokutei yugaibusshitsu narabini akushu boshi ni kansuru chosa kenkyu hokokusho (Dai 4 po)). Text in Japanese. 67p., Aug. 1969. 14 refs.

The kraft pulp and petro-chemical industries were examined as sources of offensive odors and the actual cotdition of the offensive odor was analyzed. The present state of odorous emissions from these industries, problems, and countermeasures are discussed. The offensive odors produced in the digester process of a kraft pulp industry in Fuji City, Shizuoka Prefecture were measured by a sense organ method, obtained by modifying the odorless chamber. The odors were analyzed by the salt-balanced method, the glass beads tube (selective adsorption of offensive odors), and the low temperature adsorption method (concentration of the odor by liquid oxygen). The volumes of dimethyl-disulfide, hydrogen sulfide, mercaptan, and dimethyl sulfide in the odor were great. Odors analyzed from the recovery boiler in the kraft pulp factories in Miyagi Prefecture contained 1-4 ppm methyl mercaptan, 20-300 ppm hydrogen sulfide, and approximately 1 ppm dimethyl sulfide. The volume of gas emitted at that time was 290,000 cu m. About 1% of methyl mercaptan and dimethyl sulfide was detected from the turpentine tank. Odors from petro-chemical factories in Yamaguchi Prefecture were measured by gas chromatography. The odors were composed of vinyl chloride, 1,3-butadiene, propylene oxide, acetaldehyde, methyl acetate, and ethylene dichloride.

32483

Commoner, Barry, Michael Corr, and Paul J. Stamler

THE CAUSES OF POLLUTION. Environment, 13(3):2-19, April 1971. 24 refs.

Growth in population, per capita consumption, and environmental impact per unit of production are examined as possible factors contributing to the problem of air pollution. United States data for the years 1946-1948 are examined. The change in pollution level for that time increased the range from 200 to 1000%. Population growth, however, was only 43%. The Gross National Product (GNP) increased about 126% and the GNP per capita increased about 59%. The general production classes that increased sharply in per capita consumption included synthetic organic chemicals and the products made from them; wood pulp and paper products; total production of energy; total horsepower of prime movers, especially petroleum driven vehicles; cement; aluminum; mercury used for chlorine production; and petroleum and its products. The increase was in the range of 100 to 1000%, which concurred with changes in the pollution level. The possible contributions of these activities to air pollution are examined and the use of mercury in the chemical process industries is chosen as an informative example.

32879

Hoshika, Yasuyuki

ON THE FIELD EXPERIENCE OF ODOR POLLUTION SURVEY METHOD IN KRAFT PULP INDUSTRY. (Kurafuto parupu kogyo ni okeru akushu chosa no genjoteki keiken ni tsuite). Text in Japanese. Yosui To Haisui (J. Water Waste), 13(9):1128-1135, Sept. 1971. 12 refs.

The digesting process, dehydration and scrubbing, black liquor oxidation, evaporation, and recovery boiler operations in Kraft Pulp mills are explained with a flowsheet. The Kraft Pulp Mill in Fuji City was investigated by the olfactory method and the injection method (odor concentration times exhaust quantity) on Dec. 6, 1970. Compared with other odor emission rates of a fishmeal plant complex in Yamaguchi Prefecture, (ten to the 6th power - ten to the 7th power), a fishmeal plant complex in Tokyo (ten to the 7th power - ten to the 9th power), a pharmaceutical plant complex in Tokyo (ten to the 5th power - ten to the 9th power), and a fishmeal plant complex in Yamanashi Prefecture (ten to the 8th power - ten to the 9th power), all the high emission sources being usually contained in one area, the Fuji KP Mill had three locations with more than ten to the 9th power odor emission rate. The ten locations where odor emission rates were taken all had rates between ten to the 7th power - ten to the 9th power. The three locations with high counts were 2K washer, 1K turpentine cooler, and the recovery boiler. A large portion of the emission comes from the stack exhaust gas in the recovery process, and the next largest from the digestion process; the emissions from these two sources amount to two-thirds of the total quantity. The breakdown of the sulfur compounds produced by the Kraft Pulp Mill is: CH3SH, 500 kg/500 ton pulp; (CH3)2S 1500 kg; and (CH3)2S2, 50 kg, a total of 2050 kg.

33804

Boyle, G. M.

THE EXPLOSION HAZARDS OF ESPARTO AND CREPE OR TISSUE DUSTS. Paper Technol., 12(2):153-164, April 1971. 12 refs.

The processing of esparto grass as a paper making raw material in developing countries is discussed and, to help in assessing the very dangers from dust explosions, reference is made to an explosion experienced in a Scottish mill during the last decade. Tissue or creped paper dusts have been shown to initiate an explosion which will chain react with considerable violence. When the results of these tests are related to the actual conditions viewed at some modern tissue mills, the secondary dust explosion potentials appear very real and under certain conditions could be near catastrophic. (Author summary modified)

33983

Wilson, Donald F. and Bjorn F. Hrutfiord

SEKOR IV. FORMATION OF VOLATILE ORGANIC COMPOUNDS IN THE KRAFT PULPING PROCESS. Tappi, 54(7):1094-1098, July 1971. 36 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, 56th, New York, Feb. 22-25, 1971.)

The formation of steam volatile organic compounds in the kraft pulping process other than the recovery furnace is reviewed. Reaction mechanisms for the formation of hydrocarbons, sulfur compounds, alcohols, and terpenes are determined. The route to the formation of methyl ketones was established as air oxidation of extractives followed by hydroperoxide decomposition to unsaturated ketones which undergo a reversed aldol condensation in the kraft digester. Fermentation was proposed to account for the formation of all the alcohols except methanol. Guaiacol and related phenolic compounds were determined of importance in overall kraft mill odor. (Author summary modified)

35066

Cox, L. A. and H. E. Worster

AN ASSESSMENT OF SOME SULFUR-FREE CHEMICAL PULPING PROCESSES. Tappi, 54(11):1890-1892, Nov. 1971. 34 refs. (Presented at the Technical Association of the Pulp and Paper Industry, New York, Feb. 22-25, 1971.)

Non-sulfur pulping methods to reduce emissions from the pulping process are reviewed. Nitric acid pulping delivers rapid delignification at low temperatures and atmospheric pressure, relatively high pulp yield, and useful by-products, but the chemicals are more costly, pulp strength is inferior to that of kraft pulps, and the pulp is darker in color. Single-stage alkali-oxygen pulping methods yield pulps of higher quantities and brightness values but require large chemical applications. Pulp yields in pulping with chlorine dioxide are high, but the high hemicellulose content of these pulps, high electrical costs, and corrosion problems may make the process uneconomical. The process would also emit chlorine dioxide which is very toxic and may be explosive in certain ratios with the air. (Author abstract modified)

35113

Niklasson, Rune

AIR CLEANING - NO UTOPIA ANY LONGER. REPORT ON THIS YEAR S ELMIA EXHIBITION. (Luftrening - ej langre nagon utopi rapport fran arets Elmia-utstallning). Text in Swedish. Kem. Tidskr., 83(9):46-50, 1971.

The Elmia exhibition attracted 200 exhibiters from ten countries in early September in Jonkoping. A number of industries in Sweden which envision large investments for the next couple of years for environmental protection and air pollution control are discussed. Investigations carried out in Sweden show that sulfur dioxide emissions are of large and still increasing volume, and nitrogen oxides are of next importance. Large volumes of dust are also put into the atmosphere. Outlines are given of the projects concerning environmental protection provided by the cellulose industry. Great emphasis is laid upon charting of the emission sources. Half of the total SO2 emission in the cellulose industry is created by the sulfite industry, mainly due to the pulp production on a calcium basis. There are two different solutions to this problem: switching to a magnesium basis, or flue gas cleaning. An experimental flue gas cleaning equipment was tested in continuous operation. The chemical and food industries are mentioned. A new generation of pollution measuring instruments for detecting low concentrations without surveillance is described. These instruments apply chemiluminescent substances, flame-photometric detectors, and gas chromatographs. A brief account is given of the problems and possibilities involved in dust measurements.

35443

Shannon, L. J. and P. G. Gorman

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME II - FINE PARTICLE EMISSIONS. Midwest Research Inst., Environmental Sciences Sectio Air Pollution Control Office Contract CPA-22-69-104, MRI Proj. 3326-C, 335p., Aug. 1, 1971. 139 refs. NTIS: PB 203521

The emission of fine particulates (0.01-2 micron) from industrial emission sources was statistically investigated with respect to data acquisition, particle size distribution, fractional efficiency of control methods, defined sources, emission projections, particulate sampling, and effects on human health, animals, and atmospheric modifications. Industrial emission sources included stationary combustion of coal, fuel, oil, and natural gas (power plants), crushed stone processes, iron and steel plants, (furnaces), kraft pulp mills, cement plants and kilns, asphalt plants, ferroalloys processing, lime plants, carbon black, coal preparation plants, petroleum units, municipal incinerators, fertilizer and grain processes, dryers, iron foundries, cupolas, and acids. Mobile emission sources included motor vehicles, aircraft, railroads, and water transport. Efficiency curves for electrostatic precipitators, fabric filters, scrubbers, cyclones, and multiclones were derived. Sampling devices included impactors, thermal precipitators, electrostatic precipitators, particle-size distribution analyzers, microparticle classifiers, counters, differential sedimentation techniques, and microscopic measurements. Atmosphere modifications due to particulates emissions were determined as weather pattern modifications, light scattering, decreased visibility, association with smoke plumes, and change in air composition. Projections of particulate emissions to the year 2000 are given.

35574

Vandegrift, A. E. and L. J. Shannon

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME II - HANDBOOK OF EMISSION PROPERTIES. Midwest Research Inst., Envrionmental Sciences Section, Air Pollution Control Office Contract CPA-22-69-104, MRI Proj. 3326-C, 607p., May 1, 1971. 288 refs. NTIS: PB 203522

Particulate air pollution with respect to defined stationary emission sources, chemical and physical characteristics of the particulates and the carrier gas, and current control practices was investigated. Determining factors in the study of effluent characteristic included particle size distribution, toxicity, corrosivity, soiling potential, and optical properties; particle and carrier gas properties included particle distribution and shape, density, electrical resistivity, volumetric flow rate, gas temperature, and humidity. Cyclones, wet scrubbers, electrostatic precipitators, fabric filters, and afterburners were investigated for efficiency, application, cost, and advantages. The major sources of particulate emissions examined were stationary combustion processes (coal fuel oil, and gas), including electric power generation, industrial power plants, and domestic heating; crushed stone, sand, and gravel industries; agricultural operations, e.g., field burning, grain elevators, alfalfa mills, and cotton gins; iron and steel industry; cement manufacture; forest product industry; lime manufacture; primary nonferrous metallurgy; clay products; fertilizer manufacture; asphalt plants, ferroalloy manufacture; iron foundries; secondary nonferrous metals industry; coal preparation plants; carbon black; petroleum refining; acid manufacture; and incineration. Cost relationships were derived for the control methods and corresponding sources. derived for the control methods and corresponding sources.

35581

Weiner, Jack and Lillian Roth

AIR POLLUTION IN THE PULP AND PAPER INDUSTRY. Inst. Paper Chem. Bibliog. Ser., no. 237, 67p., 1970. 208 refs.

A bibliography of 208 references and abstracts on air pollution in the pulp and paper industry is presented. Control methods, measurement and analysis techniques, air quality criteria, deodorization, basic chemical reactions, operating procedures, exonomic factors, emission toxicity, meteorological factors, effects on human health and vegetation, defined sources within the industry, control legislation, and technological improvements are examined.

36049

Mezieres, F. A.

ACCOMPLISHMENTS OF THE SWEDISH PAPER INDUSTRY IN MATTERS OF ENVIRONMENTAL PROTECTION. (Quelques realisations fe l industrie papetiere suedoise en metiere de protection de l environment). Text in French. Papeterie, 92(12):1199-1200, 1202, 1205-1208, 1211, Dec. 1970.

The Swedish pulp, paper, and fiber sheet industry produces 90% of all biochemical waste, half of it derived from the manufacture of bisulfite pulp. It used to discharge 600,000 tons of lignin into the rivers/year and 200,000 tons of sulfur dioxide into the air, equivalent to 20% of such emissions in the whole of Sweden. An important pollutant from the paper industry is mercury which is employed for producing chlorine and caustic soda, using electrolytic mercury cells. Improved arrangements have made it possible to drastically reduce the amounts of mercury in the effluents. The latest status is that, in view of the new Swedish antipollution regulations, techniques have been developed which completely eliminate the use of mercury. Other important developments are taking place with regard to residual liquors which used to be a major source of river pollution. The new installations employ a soluble base of soda or magnesium, and evaporate the residual liquor, thus largely avoiding the discharge into rivers and causing instead, as the lesser evil, increased pollution of air. Several other newly developed processes are discussed for treatment of the residual liquors obtained in the processes of boiling and bleaching. The reuse of waste fibers apparently represents one of the more difficult problems.

36348

Chilcote, David O.

STRAW UTILIZATION RESEARCH. In: Research Relating to Agricultural Field Burning. A Progress Report. Oregon State Univ., Corvallis, Agricultural Experiment Station and Oregon State Univ., Corvallis, Air Resources Center, p. 9-11, Feb, 1971. 7 refs.

Research to determine the technological and economical feasibility of straw as raw material for industrial uses and animal feed is reviewed. Problems in developing markets for straw products involve supply, densification, handling, and storage. Possible uses for straw include pulp and paper manufacture, animal feed rations, structural uses (fiberboard), manufacture, animal feed rations, structural uses (fiberboard), microbial protein production, and fuel uses.

36377

Taga, Tahakide

CONTINENTAL REPORT: ASIA. International Union of Air Pollution Prevention Associations, Intern. Clean Air Congr., Proc. London, England, 1966, p. 22-24. (Oct. 4-7 Paper II/4.)

The problem of air pollution in Formosa, the Korean Republic, the Philippines, Thailand, India, and Japan is reviewed with respect to pollutants, emission sources, control agencies, air quality measurements, and legislation. Cities with the greatest pollution problem are listed. Standards were established for dust fall from fuel combustion and incinerators, oxidants, carbon oxides, nitrogen oxides, and sulfides from commerical and industrial activities (Formosa); smoke, fumes, and dusts (including cyanides, fluorides, phosphorus compounds (Korea); soot, dust particles, sulfur dioxide, hydrogen fluoride, hydrogen sulfide, hydrogen chloride, nitrogen dioxide, chlorine, carbon dioxide, hydrogen cyanide, and ammonia (Japan). The major sources of pollution in Asia include automobiles, power plants, unpaved roads, lumber mills, chemical processing, cement factories, domestic ovens, and pulping.

36392

Hendrickson, E. R. and C. I. Harding

AIR POLLUTION PROBLEMS ASSOCIATION WITH KRAFT PULPING. International Union of Air Pollution Prevention Associations, Intern. Clean Air Congr., Proc., London, England, 1966, p. 95-97. 15 refs. (Oct. 4-7, Paper IV/6.)

Kraft pulping as an emission source is reviewed with respect to processes involved, defined sources, pollutants, and control methods. The main potential air contaminants from the pulping process are particulates (sodium carbonate, sodium sulfate, carbon, and calcium oxide) and odorous gases, including sulfur dioxide, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. The pollutants contribute to corrosion of materials and may be harmful to vegetation.

36480

Mezieres, F. A.

SCANDINAVIAN PAPER-MAKING INDUSTRY AND ENVIRONMENTAL PROTECTION. (L industrie papetiere nordique et la protection de l environnement.) Text in French. Papeterie, 93(11):1051-1055, Nov. 1971. 1 ref.

Data showing the increase in the production of the paper-making industries of the Scandinavian countries (Finland, Sweden, Norway) are presented for the period 1953-1969. The paper-making industries in the above countries cooperate in their efforts to control pollution. A number of institutions responsible for handling air pollution problems in these countries are referred to with their respective tasks (research and development) specified. Measures taken to control malodorous gases from sulfate pulp factories are reviewed. To solve the problem involved in bisulfite lyes economically, lime has to be replaced by soluble bases such as soda or magnesia. Various processes and systems are described. Biological purification methods for paper-mills are relatively new in the Scandinavian countries. Experiments and practical uses of biological purification are referred to. Scandinavian paper industry helps other industries in solving their pollution problems, chiefly through providing them with adequate materials, and maintains intense cooperation with communities. This is exemplified by a system used by Union Co., Norway which burns its own waste bark together with domestic refuse.

38327

Klimovich, J. and J. L. McAndie

THE REVOLUTION IN THE AMERICAN PAPER INDUSTRY IN THE MATTER OF POLLUTION. (La revolution de l industrie papetiere americaine en matiere de pollution). Text in French. Patetiere, 93(11):1061-1066, Nov. 1971.

Since 1970, the pulp and paper industries have greatly increased their investments in anti-pollution measures, to comply with the latest regulations. For 1972, an estimated expenditure of around $180 million is predicted. This would be equivalent to an investment cost of about $3/ton of manufactured product. The cost of operating the purification equipment amounts to $1-2/ton produced. The major source of pollution in the past was the discharge of effluents into rivers. With the new methods, the effluents are first brought into settling reservoirs which are mostly of a circular shape. The settled sludge is removed by an internal mechanical wiping device, transported by pumping to a filter assembly, and moved into a sludge press. The squeezed-out sludge is then disposed of by incineration or dumping. The remaining liquid part of the effluent is subjected to a second stage treatment, which starts in a mixing tank where nitrogen and phosphorus are added as nutrients, and lime for pH adjustment. From there the liquid is transferred into a series of aerated basins where it is left for a period of several days; all biological activity is brought to an end, and the bacterial flora is consumed by the dissolved additives. The pulp manufacturing process involves several sources of air pollution, such as waste gases from the washer and the blow tank, non-condensable gas from the evaporator, and flue gases from the regeneration boiler. Some of the waste gases generated in these processes are accumulated and transferred to the lime kiln for joint combustion. The regeneration boiler represents the biggest source of air pollution, particularly due to the last stage of evaporation of the residual liquor by direct contact with the fumes, which causes a strong emission of sulfur. Modified technologies are applied in new installations, designed to suppress the fume and odor formation of the aforementioned last stage.

38542

Winthrop, S. O.

AIR POLLUTION IN THE URBAN ENVIRONMENT. Occupational Health Rev. (Ottawa), 22(1/2):26-35, 1971. (Presented at the Symposium on Solutions for Pollution in the Urban Environment, Montreal, Quebec, Nov. 30, 1970.)

The problem of air pollution in the urban environment, with regard to sources, effects on the total ecological system, and possible control methods, is reviewed. Air pollution is one of the most difficult and sensitive problems today and is intimately related with meteorology, weather, and atmospheric chemistry. The greatest source of air pollutants is the combustion of fossil fuels. Other important sources include iron and steel manufacturing, metal smelting, oil refining, pulp and paper manufacturing, and chemical and petrochemical operations. The major pollutants include suspended particulates, sulfur dioxide, carbon monoxide, nitrogen oxides, hydrocarbons, and oxidants. There are two main categories of air pollution effects on human health: discomfort and annoyance and actual physical injury. Air pollution is a contributing factor to the rising incidence of chronic respiratory diseases including lung cancer, emphysema, bronchitis, and asthma. Visibility deterioration, materials damage, and destruction to vegetation are also prevalent. Research into the epidemiology of pollution-effected diseases and toward the development of new control technology is a clear necessity. Costs of air pollution damage are high.

38615

Barnea, Matei and Pascu Ursu

PROCESSES AND SOURCES OF AIR CONTAMINATION. (Procese si surse de impurificare aerului). Text in Rumanian. In: Protectia atmosferei impotriva impurificarii cu pulberi si gaze. Bucharest, Romania, Editura Tehnica, 1969, Chapt. 1-6, p. 10-128. 86 refs.

Seventy-four main air pollutant sources located in 40 populated areas were identified in Romania according to an inquiry carried out in 1966. These sources include mineral fertilizer manufacturing plants, inorganic and organic chemical processing plants, rubber and synthetic fiber manufacturing, metallurgical processing, paper manufacturing, and thermal power plants. Basic factors affecting air pollution and selfpurification processes are discussed in terms of source, meteorological conditions, and topographic interactions. Emission and dispersion of solid and gaseous air pollutants is analyzed in relation to the height of stacks and to meteorology. Included are alignment charts developed according to Stuemke for the design of stacks.

39460

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME I - MASS EMISSIONS. Midwest Research Inst., Kansas City, Mo., Air Pollution Control Office Contract CPA 22-69-104, MRI Proj. 3326-C, 372p., May 1, 1971. 198 refs.

A program to assess particulate air pollution from stationary sources in the continental United States and to advance the capability of control equipment for particulates was conducted. All significant sources of particulate pollutants are identified, and the most important sources are evaluated. Future problem particulate emission sources, determined by projecting production trends, control efficiency, and control equipment application trends, were identified. Research and development plans were formulated to fill in the knowledge gaps pinpointed during the study. From the list of significant sources, a ranking of the most important sources by total tonnage emitted was developed by calculating total emissions using emission factor techniques and other calculation methods. Important sources by tonnage are fuel combustion in stationary sources; crushed stone, sand, and gravel; operations related to agriculture; iron and steel manufacturing; cement plants; forest products; lime; clay products; primary nonferrous metals; fertilizer manufacturing; asphalt; ferroalloys; iron foundries; secondary nonferrous metals; coal preparation plants; carbon black; petroleum refining; and acid manufacturing. Sources and air pollutants were ranked by objectionable properties. In order they were: carcinogens, beryllium and mercury, toxic metals, mercaptans, isocyanates, asbestos and silicates, very toxic metals, fluorides, alkyl amines, hydrogen sulfide, calcium oxide, mineral acids (hydrochloric, nitric, sulfuric, and phosphoric acids), sulfates, nitrates, sulfur oxides, organic sulfides, pyridines, nitrogen oxides, chlorine, soot, smoke, carbon black, less toxic metals, fly ash, inert particulates, oxidants such as ozone, olefins, aldehydes, phenols, aniline, aromatics, chlorocarbons, mixed organics, ammonia, hydrocarbons, and carbon monoxide.

39461

Midwest Research Inst., Kansas City, Mo.

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME II - FINE PARTICLE EMISSIONS. Air Pollution Control Office Contract CPA 22-69-104, MRI Proj. 3326-C, 335p., Aug. 1, 1971. 87 refs.

A program was conducted to quantify fine particle emissions (0.01 to 2 micron) from particulate pollution sources. The primary objective was to use the best data currently available on particle size distributions of particulates from uncontrolled and controlled sources, fractional efficiency curves for specific control devices, and the degree of application of control equipment on specific sources to estimate the mass and number of fine particles emitted from particulate pollution sources. Secondary objectives were the assessment of the applicability of standard sampling and particle sizing methods to the fine particle regime, and the current understanding of the adverse effects of fine particulate pollutants on human health. Major sources were stationary combustion (coal, fuel oil, natural gas, and liquified petroleum gas used in industries and electric utilities); crushed stone; iron and steel manufacturing (sintering, open hearth furnaces, basic oxygen furnaces, electric arc furnances); kraft pulp mills; cement plants and rotary kilns; hot-mix asphalt plants; ferroalloys; lime plants; secondary nonferrous metallurgy; carbon black; coal preparation plants; petroleum refining; incinerators; fertilizer manufacturing; iron foundries and cupolas; and sulfuric and phosphoric acid manufacturing. Efficiency of control equipment including electrostatic precipitators, fabric filters, wet scrubbers, and cyclones is also discussed. Projections of particulate emissions to the year 2000 and modifications of the atmosphere by particulate pollution are mentioned.

39462

Midwest Research Inst., Kansas City, Mo.

PARTICULATE POLLUTANT SYSTEM STUDY. VOLUME III - HANDBOOK OF EMISSION PROPERTIES. Air Pollution Control Office Contract CPA 22-69-104, MRI Proj. 3326-C, 626p., May 1, 1971. 302 refs.

Details of the methodology employed to obtain data concerning the kind and number of stationary particulate sources, the chemical and physical characteristics of both the particulates and carrier gas emitted by specific sources, and the status of current control practices, are presented. Emission factors and rates, chemical and physical properties of effluents, and control practices and equipment are given for stationary combustion processes (power generation and furnaces); mineral processing; agricultural operations (field burning, grain elevators, cotton gins); iron and steel manufacturing; cement manufacturing; forest products industry (sawmills, pulp industry); primary nonferrous metallurgy (copper, lead, zinc, and aluminum smelting and refining); clay products; fertilizer manufacturing; asphalt; ferroalloy manufacturing; iron foundries; secondary nonferrous metals industry; coal preparation; carbon black manufacturing; petroleum refining; acid manufacture (sulfuric acid and phosphoric acid); and incineration. The control equipment includes cyclones, wet scrubbers, electrostatic precipitators, fabric filters, mist eliminators, and afterburners. Effluents include dusts, particulates, fly ash, sulfur oxides, hydrocarbons, and other noxious gases. Costs for control equipment purchase and operation are given. This handbook constitutes a reference source for available information on the distinguishing features of the various particulate pollution sources and should be of value to air pollution regulatory agencies, control equipment manufacturers, and industrial concerns.

39922

Bergstrom, Hilding and K. G. Trobeck

SULFUR LOSSES IN THE PRODUCTION OF SULFATE CELLULOSE. (Svavelforluster vid sulfatcellulosaframstallningen). Text in Swedish. Svensk Papperstid. (Stockholm), 48(3):49-54, Feb. 15, 1945.

Sulfur losses occurring in different stages of sulfate cellulose production were determined with particular emphasis on non-condensable gaseous compounds. Non-condensed gases from cookers and diffusors contained 11.3 mg/l of hydrogen sulfide, 405 mg/l methyl mercaptan, and 5.3 mg/l dimethyl sulfide. Laboratory tests revealed H2S concentrations of 6.7-13.9 mg/l due to the presence of air. Waste gases from the evaporation of the black liquor contained 76.4 mg H2S and 3.5 mg CH3SH per liter, and a production rate of 7.8 tons of sulfate cellulose per hour accounted for losses of 4.69 kg H2S and 0.22 kg CH3SH. The gaseous sulfur compounds from the black liquor combustion (1.30 mg H2S, 2.65 mg CH3SH, and 0.32 mg (CH3)2S per liter) totaled a sulfur loss of 3.19 mg/l. Different procedures used for the determination of the gaseous sulfur compounds in various stages of production are described.

40063

Tsuchiya, Gordon and Lennart N. Johanson

PREDICTION OF GENERATION AND RELEASE OF ODOROUS GASES FROM KRAFT PULP MILLS. Tappi, 55(5):777-783, May 1972. 24 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, New York, N. Y., Feb. 16-19, 1970.)

Industrial measurement of the concentration and quantity of odorous gases released in kraft mill operation is often difficult, costly, and of uncertain reliability. To supplement such measurements, a study has been made of the expected release of volatile constituents from a typical kraft mill utilizing a continuous digester. Constituents considered include hydrogen sulfide, methyl mercaptan (methane thiol), methyl sulfide, dimethyl disulfide, alpha-pinene, and alpha-terpineol. Consideration was given to the amount of terpenes occurring in the wood, the kinetics of generation of methyl mercaptan and methyl sulfide, the vapor-liquid equilibrium of each compound in the presence of water, the influence of pH on the volatility of hydrogen sulfide and methyl mercaptan, and the influence of oxidation system efficiency. Results are in qualitative agreement with most mill measurements available. The terpenes and methyl sulfide are released early in the recovery cycle. The release of hydrogen sulfide and methyl mercaptan is greatly dependent upon oxidation efficiency and upon pH. Under unfavorable circumstances, appreciable quantities of these constituents may appear in the evaporator condensates and vapors from direct-contact evaporators. (Author abstract)

40159

Brandt, A. D. and D. M. Anderson

MEASURES AGAINST AIR POLLUTION CAUSED BY INDUSTRIAL SOURCES. (De strijd tegen de luchtvervuiling afkomstig van industriele bronnen). Text in Dutch. Polytech. Tijdschr., Ed. Procestechniek (The Hague), 27(7):231-237, 1972. 26 refs. (Presented at the Environmental Control Seminar, Rotterdam, Netherlands, May 25-26, 1971).

A general survey is given of air pollution from industrial sources in the United States, with special regard to particulate, gaseous, and fluorine pollution. The contribution of industry to air pollution was 14% with 30 million tons in 1968. Particulate pollutants are most important, followed by sulfur dioxide, hydrocarbons, carbon monoxide, and gaseous and particulate fluorine compounds. To effectively control air pollution, improved source localization techniques are required. General principles and uses of pollution control equipment such as cyclones, tissue filters, scurbbers, and electrostatic filters are reviewed. Contributions of several industries to particulate and gaseous pollution in 1967 are reviewed. Quarrying, gravel, and sand processing was the major source of particulate emissions with 4.6 million tons, followed by grain mills with 2.952 million tons. Compared to other industries, a high proportion of the emission sources is localized in the iron and steel industry, (1.490 million tons). Cokeries are a major source of HC emissions. The respective contributions by the paper and asphalt industries were 633,000 and 522,000 tons. The joint share of the cement and lime industries is 744,000 tons, followed by foundries with 217,000 tons. Brick manufacturing was responsible for the bulk of fluorine emissions. The chief sources of sulfur dioxide, carbon monoxide, and hydrocarbon emissions were primary nonferrous smelting (2,940,000 tons from the copper industry alone), petroleum refining (6.2 million tons), and petroleum products processing (1.1 million tons), respectively.

40345

LaGrone, F. Scott and Clinton E. Burklin

FINAL REPORT FOR STATEWIDE EMISSIONS INVENTORY FOR THE STATE OF LOUISIANA. Radian Corp., Austin, Tex., Office of Air Programs APTD-0794, 77p., Sept. 8, 1971. 14 refs. NTIS: PB 204949

Area and point source emissions of sulfur compounds (sulfur dioxide and sulfur trioxide), particulates, carbon monoxide, nitric oxide, nitrogen dioxide, and hydrocarbons and their derivatives were calculated within an emission inventory for Louisiana. Procedures involved in gathering data on emissions and fuel consumption, determination of the grid systems, survey methodology, data analysis, and actual calculations of emissions are reviewed. The point sources included chemical processing, coal cleaning, detergent and soap manufacturing, ink manufacturing, paint and varnish production, fertilizer plants, synthetic fiber and rubber production, food and feed operations, rendering, primary and secondary metallurgical processes, mineral processing, petroleum refining, pulp and paper manufacture, dry cleaning, surface coating operations, gasoline marketing, steam-electric power plants, incinerators, and open burning dumps. Area source emissions were calculated from combustion and consumption data on coal, fuel oil, natural gas, residual oil, and distillate oil with vessels, railroads, diesel motor vehicles, gasoline motor vehicles, airport operations, solid waste disposal, and process losses as major area sources. Sample inventory forms, data tabulations, and area maps are included.

40524

Ishiguro, Tatsukichi

MEASUREMENT AND EVALUATION METHODS OF ODOR POLLUTANTS AT SOURCES AND ENVIRONMENT. (1). (Hasseigen ya kankyo ni okeru akushu osenshitsu no sokutei ya hyoka no shohoho, sonoichi). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(5):20-25, Aug. 1971.

This is a brief report on the Third Symposium on Environmental Health, sponsored by the Kaolinska Association and held in Stockholm from June 1 to 5, 1970. The symposium members, an ntroductory statement concerning the world-wide problems of bad odor pollution, and some points and trends are discussed. Most reports were on the measurement of odor pollutants and various methods of evaluation, based on special studies of pulp mill exhausts and automobile exhaust. However, these are by no means the only or major emission sources of bad odor. Kraft pulp mills were in particular the center of discussion. Determination of bad odor emission standards seems to be the most important problem at present. This is to be derived from the standpoint of concentration, exposure time, meteorological mutual reactions, and all other overt and hidden factors. The odor emission standard is scheduled to be announced in the United States in 1972, and according to these standards, odor control programs and enforcement plans are to be applied starting in 1973. Oregon and Washington have special regulations concerning emission of odor pollutants from pulp mills. In these states, the total sulfur emission from the recovery boiler of Kraft Pulp mills are expected to be reduced to 2 lbs/ton of pulp; by July 1975, this will further be reduced to 0.5 lb/ton.

41168

Kikuchi, K., S. Sata, H. Funaki, H. Sone, and K. Saito

BAD ODOR EMISSION SOURCES IN KP PLANTS. (KP kojochu no akushu hasseigen ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):149, 1969. (Presented at the Japan Society of Air Pollution, Annual Meeting, 10th, 1969.)

Exhaust gas was sampled at several process emission sources in a kraft pulp mill. The gas was captured and condensed by acetone of -78 deg, and its volatile organic compounds were measured by gas chromatography. Methyl mercaptan and dimethyl sulfide were detected in the flue gas of the recovery boiler, and in the blow tank exhaust and turpentine tank exhaust in the distillation process. The organic sulfide concentration of the recovery boiler was only several ppm, but tthe blow tank concentration of dimethyl sulfide was close to 300 ppm and gas from the turpentine tank had considerably greater concentrations of CH3SH and CH3SCH, on the order of 14,000 ppm. These seemed to be the main source of bad odor. Since the odor thresholds of these substances are very low, the emission gases from the blow tank and turpentine tank can be considered major sources of public nuisance.

41467

Miles, F. W.

URBAN NUCLEAR ENERGY CENTER STUDY: ESTIMATES OF PROCESS STEAM CONSUMPTION BY MANUFACTURING INDUSTRIES IN THE UNITED STATES. Oak Ridge National Lab., Tenn., Chemical Technology Div. and Oak Ridge National Lab., Tenn., Reactor Div., Dept of Housing and Urban Development Contract W-7405-eng-26, IAA-H-3-69, Rept. ORNL- HUD-2, UC-38, 19p., Jan. 1970. 15 refs. NTIS: ORNL-HUD-2

The rate of consumption of process steam by manufacturing industries in the United States for the year 1980 was estimated as part of a program for evaluating the usefulness of urban nuclear energy centers. Perazichtype assumptions were made with respect to the use of steam by the food, paper, chemicals, petroleum, rubber, and textile industries. Steam consumption in 1962 was estimated by several methods for selected industries from fuel consumption data and the values were projected to 1980. The estimates of steam consumption for 1980 varied from 67.6 times 10 to the 14th power to 95.4 times 10 to the 14th power Btu depending on the methods and assumptions employed. This estimated consumption of steam by manufacturing industries is approximately equal to the 92 times 10 to the 14th power Btu of electrical energy estimated to be required in 1980. This indicated that a significant amount of thermal energy from an urban nuclear energy center would be consumed by manufacturing industries if the area served by the center had a fraction of the country s steam-using industries equal to its fraction of the country s population.

41564

Nadeau, Jean-Paul

POLLUTION, PRODUCTIVITY, AND BENEFIT IN THE PULP AND PAPER INDUSTRY OF QUEBEC. (Pollution, productivite et rentabilite de l industri des pates et papiers du Quebec). Text in French. Papeterie, 94(5):376, 379, 380, 1972. 5 refs.

The impact of water and air pollution control on the productivity and benefit of the pulp and paper industry of Quebec is outlined. The rate of growth of the pulp and paper industry is below the average of the manufacturing industry as a whole, which, along with problems created by pollution control measures, calls for both expansion and structural changes in the paper industry. The capital costs of waste water treatment in the total pulp and paper industry of Canada are estimated to be $350 million, while the corresponding expenditure for air pollution control at a sulfate (kraft) paper plant with 500 t/day capacity lies at $2 million. The additional production costs due to air and water pollution control lie at 3% ($3 per ton) and about 4%, respectively. The additional costs as expressed in the percentage of the average sale price are estimated to be 3.5% for sulfate and mechanic pulp and 10% for bisulfite pulp. A 3% rise in the sale is expected to result in a decline of 3.5% in the total volume of sales. Adequate adjustments to pollution control in the pulp and paper industry are an urgent need. The pollution caused by old pulp and paper manufacturing plants is required to be reduced by 70%.

42266

Washington State Dept. of Health, Seattle, Office of Air Quality Control

AIR POLLUTION FROM THE KRAFT PULPING INDUSTRY: REPORT TO THE WASHINGTON AIR POLLUTION CONTROL BOARD PREPARED IN CONJUNCTION WITH RULES AND REGULATIONS FOR KRAFT PULP MILLS IN WASHINGTON. 21p., May 1969. 10 refs.

From a survey of the chemical pulping industry in the state of Washington, basic information was assembled relating to economic factors, process technology, associated air-pollution control equipment, and emissions of air contaminants. Background economic data include daily production, replacement costs, air-pollution control equipment costs, total employees, and population within a 10-mile radius of the 20 plants. The largest source of potential particulate emissions, including sodium carbonate, sodium sulfate, calcium oxide, sodium oxide, carbon, and fly ash, is the recovery furnace. Other sources of particulate emissions include the lime kilms, smelt tanks, and hog fuel boilers. The recovery furnace also account for half of the total potential sulfur emissions. Other sources of sulfur oxide and total reduced sulfur compounds include power boilers, lime kilns, knotters, brown stock pulp washers, multi-effect evaporators, digesters, blow tanks, smelt tanks, blow heat accumulators, black liquor storage tanks and oxidation systems, tall oil recovery operations, and handling of condensate liquids. Water vapor is also emitted from many mill operations. Proposed standards and effects of those standards at several plants for TRS emissions from recovery furnaces, particulate emissions from recovery furnaces, lime kilns, and smelt tanks, and noncondensible emissions from multi-effect evaporators and digesters are described. Special studies are to be undertaken to evaluate sulfur oxide emissions, water vapor emissions, and TRS emissions from sources other than the recovery furnace. Electrostatic precipitators and scrubbers will be employed in order to meet the proposed standards.

43274

Environmental Protection Agency, Research Triangle Park, N. C., Office of Air Programs

WOOD PROCESSING. In: Compilation of Air Pollutant Emission Factors. OAP Pub-AP-42, p. 10-1 to 10-5, Feb. 1972. 10 refs. NTIS: PB 209559

Wood pulping operations for the manufacture of pulp, paperboard, and fiber board are discussed. The kraft process of wood pulping and pulp board production processes are described. Major emissions are particulates, sulfur dioxide, carbon monoxide, and hydrogen sulfide. Control methods used are electrostatic precipitators, scrubbers, and venturri scrubbers.

43289

Environmental Engineering, Inc., Gainesville, Fla.

BACKGROUND INFORMATION FOR ESTABLISHMENT OF NATIONAL STANDARDS OF PERFORMANCE FOR NEW SOURCES: PULP AND PAPER INDUSTRY. Environmental Protection Agency, Div. of Abatement Contract CPA-70-142, Task Order 2, 98p., March 15, 1971. 44 refs.

The important atmospheric emissions from the pulp and paper industry result from the chemical production of pulp. The kraft process is used to produce 75% of the domestic tonnage of paper pulp. Valid information on emissions is sparse due to the slow development of analytical hardware. The kraft process is notorious for its air pollution control difficulties. Emissions of the reduced sulfur gases, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide occur during nearly every phase of the kraft process. Digesters and multi-effect evaporators are the largest sources. It is estimated that the most up to date mill equipped with the control systems available would pay $1.25/air dried ton of pulp and conform to very strict emission requirements. Standards for new mills are set for each of the procedures in the kraft process. No standards can be set for other processes because of the scarcity of data. The conversion cost for older mills is thought to be prohibitive.

43626

Andersson, Kjell

METHODS FOR REDUCING TOTAL SULPHUR EMISSION TO ATMOSPHERE FROM A SULPHATE MILL. Int. Air Pollut. Control Noise Abatement Exhib. Conf. (Proc.), Jonkoping, Sweden, 1971, p. 2:41-2:52. (Sept. 1-6.)

Sulfur emission from sulfate mills and methods to reduce sulfur emissions are discussed. Emissions from sulfate mills include hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and sulfur dioxide. Four cases of sulfate mill production procedures are presented. To reduce sulfur compound emissions, the following procedures are recommended: installation of a deodorizing system, reducing alkali losses, absorption with sodium hydroxide in a scrubber, and recycling of sulfur dioxide.

B. CONTROL METHODS

00025

P. A. Kenline and J. M. Hales

AIR POLLUTION AND THE KRAFT PULPING INDUSTRY (AN ANNOTATED BIBLIOGRAPHY). Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. (999-AP-4) Nov. 1963, 126 pp.

Since the first kraft mill came into existence in 1891, the potential odor problem has been well recognized. Accordingly, a great deal of literature has been published describing practical and theoretical work in the field of kraft mill odor control. Some progress has been made, but even today most kraft mills are faced with serious problems of atmospheric pollution. The following work provides an annotated bibliography of articles concerning measurement and control of kraft mill air-borne pollution currently available in the literature. It is the author's intention that this should provide a retrospective view of what has been accomplished and should form a sound basis for further work in the field. In addition to 154 abstracts, this bibliography contains a description of the kraft pulping process, a survey of mill emissions, and a consideration of control measures. (Author)

00379

G. A. Jansen and D. F. Adams

ABSORPTION AND CHLORINE OXIDATION OF SULFUR COMPOUNDS ASSOCIATED WITH KRAFT MILL EFFLUENT GASES. Preprint. 1966.

Absorption of methyl mercaptan and H2S into aqueous solutions of Cl, NaOH, and Cl plus NaOH has been studied using a 2 in diameter absorption column packed with 1/4 in. Intalox saddles. Absorption rates were noticeably affected by chemical reactions occurring in aqueous Cl and OH media. Potentiometric methods were used to follow the reactions of mercaptan and sulfide in aqueous chlorine solutions. Mercaptan apparently was converted by aqueous Cl absorption media to dimethyl disulfide and stripped off in the effluent gas. The percentage conversion increased with increasing pH. The absorption of H2S in aqueous Cl (pH 2 to 13) was highly pH dependent. The absorption rate increased slowly as the pH of the feed solution increased to pH 11. Sulfate was the resulting oxidation product. At pH 11, the rate of absorption dropped slightly, then rose sharply at pH 12. Elemental S became the major product at pH 12 and above and fouling of the packed column occurred. The effect of pH on formation of sulfate and/or elemental S in chlorine-sulfide reactions was explained by Choppin and Faulkenberry (1937). The absorption of sulfide in aqueous NaOH increased until the feed hydroxide to sulfide ratio was 1. At higher ratios, the absorption rate remained constant. Apparently, sodium bisulfide was the absorption product. The results of these studies indicate that aqueous Cl solutions at pH above 12 can be effectively used for removal of H2S in absorption equipment designed to handle S in suspension. The absorption of methyl mercaptan in aqueous Cl solution appeared to be impractical since dimethyl disulfide was apparently the only product formed and was stripped from the tower by the gas stream. Hydroxide solution was effective for absorption of both methyl mercaptan and H2S when hydroxide to sulfide or mercaptan feed ratios were greater than 1 or 1.8 respectively. (Author)

00390

Murray, F. E.

THE CONTROL OF KRAFT MILL ODORS. Occup. Health Rev., 17(2):23-25, 1965.

The Control of Kraft Mill Odors: The kraft or sulfate process for making wood pulp is outlined and the points at which the release of odor occurs are described. The control procedures used to reduce kraft mill odor at various mills are discussed along with the results achieved. The limitations of chemical analytical methods and the concept of odor threshold are considered briefly. (Author's abstract)

00552

F.H. Cady

A KRAFT MILL WASTE CHLORINE GAS RECOVERY SCRUBBER. Preprint. (Presented at the Second Annual Meeting, Pacific Northwest International Section, Air Pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

Although most of the normal air contaminants around Weyerhaeuser's Kraft Pulp Mill at Everett, Washington had been removed, obnoxious waste chlorine gases occasionally produced poor working conditions. A caustic gas-recovery scrubber with appropriate ductwork was installed. This scrubber, while removing the waste gases from the atmosphere, pays for itself by the resulting formation of hypochlorite bleach liquor. (Author's abstract)

00951

S. F. Galeano and C. I. Harding

SO2 REMOVAL AND RECOVERY FROM PULP MILL POWER PLANTS. (Presented at the 59th Annual Meeting, Air Pollution Control Association, San Francisco, Calif., June 20-25, 1966, Paper No. 66-97.)

The special circumstances unique to pulp mills -- on-site power production and a demand for sulfur compounds in the cooking liquor -- suggest the possibility that wet scrubbing for SO2 removal from boiler flue gas might be economically feasible. Since the neutral sulfite-semi-chemical process (NSSC) is widely used and possibly could utilize the recovered sulfite with no further processing, it was selected as our starting point. One of the main advantages of the NSSC process is the fact that a high pulp yield is obtained because much of the hemicellulose lost in conventional chemical pulping is not cooked out of the pulp. Another important feature is that the production of a high-yield pulp can be extended to non-wood fibrous materials such as sugar cane bagasse and cereal straws. This opens the door to further expansion of this process if the chemical make-up costs are eliminated. The work reported in this paper is limited to the production of NSSC cooking liquor from recovered SO2 in a NSSC mill or a composite mill utilizing this process as part of its total operation.

01223

M. Benjamin

AN EXAMPLE OF PLANNING FOR POLLUTION CONTROL IN KRAFT PULPING. J. Air Pollution Control Assoc. 16, (3) 128-30, Mar. 1966. (See attached letter from J. Air Pollution Control Assoc. 16, (11) 639, Nov. 1966.)

This paper will not contribute any new technology. It will, however, indicate how an established plant, in a large urban area, has planned and taken action to solve a pollution problem. Planning in this situation is used in a broad sense. It includes education and training of personnel, changes in process, capital expenditure and new installations, constant attention to maintenance and control, utilization of research and development from all sources, and relations with the public and regulatory agencies. (Author abstract)

01436

G. A. Jensen, D. F. Adams, and H. Stern

ABSORPTION OF HYDROGEN SULFIDE AND METHYL MERCAPTAN FROM DILUTE GAS MISTURES . J. Air Pollution Control Assoc., 16(5):248-253, May 1966.

The absorption of hydrogen sulfide and methyl mercaptan by aqueous solutions of chlorine, sodium hydroxide, and chlorine plus sodium hydroxide was studied using a two-inch diameter absorption column packed with 1/4 inch Intalox saddles. Absorption rates were noticeably affected by chemical reactions occurring in the aqueous chlorine and hydroxide media. These solutions were studied as a means of controlling sulfur-containing gas emissions from kraft paper mills. The absorption studies indicated that aqueous chlorine solutions at a pH above 12 were effective absorbents for hydrogen sulfide removal in absorption equipment designed to tolerate sulfur in suspension. The absorption of methyl mercaptan in aqueous chlorine solutions appeared to be impractical since dimethyl disulfide was apparently the only product formed and was stripped from the tower by the gas stream. Sodium hydroxide solution was an effective absorbent for both methyl mercaptan and hydrogen sulfide when hydroxide to sulfide or mercaptan feed ratios were greater than 1 or 1.8, respectively. The mercaptan absorption coefficient was approximately twice that for sulfide absorption. (Author abstract)

01505

C. I. Harding and J. E. Landry

FUTURE TRENDS IN AIR POLLUTION CONTROL IN THE KRAFT PULPING INDUSTRY. TAPPI 49(8):61A-7A, Aug. 1966. (Presented at the Annual Meeting, National Council for Stream Improvement, New York City, Feb. 21-24, 1966.)

Measured gaseous and particulate emission figures are presented with recent advances in emission control technology as bases for proposing the types and extent of emission control to be utilized by the pulp industry during the next 5 yrs. A major detrimental effect is the corrosive nature of the particulate and gaseous emissions from kraft pulping. Sources of sulfur compounds are 2 large kraft mills and 2 large oil-fired electric generating stations. Sampling can be done by simple tests to give total monthly exposure. Three determinations are dustfall, lead peroxide candles for sulfation rates, and corrosion rate measurements. Subjective tests for odors and odor intensity can be accomplished through odor panels or odor recorders at various distances from the mill. A simple wet technique for measuring the concentrations of SO2, hydrogen sulfide, mercaptans, organic sulfides, and organic disulfides in mill vents was developed and has been utilized in Southern mills.

01549

S. Lindberg

HOW UDDEHOLM DESTROYS AIR AND WATER POLLUTANTS AT THE SKOGHALL WORKS. Svensk Papperstid. (Stockholm), 69(15):484-487, Aug. 15, 1966.

Measures taken at the Skoghall sulfate mill in order to eliminate malodorous air and water polutants are described. The malodorous gases are destroyed by combustion. Gaseous mixtures not containing oxygen are burned in a recovery boilder. The gases, however, which are mixed with air on cleection, are eliminated in a specially designed furnace installed as a preliminary oven to a conventional boiler. The worst water pollutants are cooking and evaporation condensates. Before being released into the recipient, the cooking condensate is freed from malodorous components by blowing with steam through a column. The evaporation condensate, whose impurity mainly consists of hydrogen sulfide, is scrubbed in a satisfactory manner by mixture with blackwater from the chlorination stage of the bleaching plant. The total sulfide content in the waste water has been reduced from 6 lbs. to 1 lb. H2S per ton pulp. These measures have given the desired results, and the plant now functions in a safe manner. The capital outlay has been moderate and the process costs are very low. (Author summary)

01563

R. C. Gumerman and D. A. Carlson

METHYL MERCAPTAN REMOVAL BY SOIL FILTRATION. Preprint. (Presented at the Annual Meeting of the Pacific Northwest International Section, Air Pollution Control Association, VANCOUVER, BRITISH COLUMBIA, NOV. 2-4, 1965.)

The use of soil bacteria as a method for removing odor from gaseous mixtures appears highly feasible. In this study, efficiencies approaching 100% removal were obtained after a six-week acclimation period, using only three and one-half feet of soil. Apparently this is not the limit toward applicability of this method, since at the end of the six-week study period, the bacterial population was still increasing, indicating further potential still to be displayed. Although this idea could be applicable in itself in large installations such as kraft pulp mills, it may be more economically promising if it could be used in conjunction with a spray irrigation network used for the removal of excess BOD in the waste liquor. In essence, this would provide double benefit from the land. This idea assumes that the spent liquor is not toxic to the odor reducing microbes, and conversely that the odor is not toxic to the waste utilizing microbes. As an additional benefit, the alkaline waste liquor would keep the soil pH from consistently dropping as was shown to occur in this research. Although this idea is only a hypothesis, it is felt that due consideration should be given to it, as it performs the dual role of odor and BOD removal, which would be of economic advantage to any kraft mill utilizing it. (Author conclusions)

01672

U. S. Public Health Service, Washington, D. C., Div. of Air Pollution

REPORT ON INTERSTATE AIR POLLUTION IN THE SHOREHAM, VERMONT - TICONDEROGA, NEW YORK, AREA. Preprint, ((43))p., 1965. 14 refs.

A summary is presented of the activities undertaken by the Abatement Branch, Division of Air Pollution, Public Health Service, DHEW, subsequent to a request by the Vermont government alleging that air pollution emanating from an International Paper Company pulp plant in Ticonderoga, New

York, endangers the health and welfare of persons in nearby Vermont. The activities of the Abatement Branch were threefold: (1) inspection of the pulp mill operated by the International Paper Company in Ticonderoga, New York, (2) review of available topographical and meteorological information, and (3) calculations of emissions, transport and diffusion of odorous materials from the mill site.

01789

C.I. Harding E.R. Hendrickson

FOAM FRACTIONATION OF BLACK LIQUOR FROM SULFATE PULPING. J. Air Pollution Control Assoc. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Texas, June 20-21, 1964.) 14, (12), 491-9, Dec. 1964.

The principal deterrent of general acceptance of weak black liquor oxidation by mills pulping southern pine is the extensive foam produced during the oxidation of the liquor. The foam results from relatively high concentrations of fatty and rosin acid soaps remaining in the black liquor after roughly 75% of these compounds have been removed by skimming as marketable by-products recovery while the black liquor is being oxidized. This paper will report the results of foam fractionation studies on such black liquors conducted in this laboratory. (Author abstract)

01900

E. R. Hendrickson and C. I. Harding.

BLACK LIQUOR OXIDATION AS A METHOD FOR REDUCING AIR POLLUTION FROM SULFATE PULPING. J. Air Pollution Control Assoc. 14, (12) 487-90, Dec. 1964. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 20-21, 1964.)

This paper will discuss the sources of odorous air pollutants from sulfate pulping operations. One of the major sources is the recovery furnace. Odors from this source can be reduced considerably by oxidation of the black liquor prior to evaporation and burning. The procedure has been used with considerable success in the northwestern and northeastern parts of the United States. Unfortunately, the majority of sulfate pulp production occurs in areas where southern pine is the basic raw material. For several reasons the black liquor resulting from southern pine operations presents problems when the usual oxidation procedures are used. Although not as effective as normal balck liquor oxidation strong black liquor can be oxidized without too much difficulty. Various procedures of oxidation of black liquor will be discussed. Results of stack sampling in U.S. pulp mills with and without the oxidation unit in operation will be reported. (Author abstract)

02018

E.R. Hendrickson C.I. Harding

AIR POLLUTION PROBLEMS ASSOCIATED WITH 'KRAFT' PULPING. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper IV/6). pp. 95-7.

The Air Pollution Research Laboratory of the University of Florida has been investigating air pollution problems of the kraft pulping industry since the early 1950's. The problems of this industry involve emission of a variety of particulates plus odorous and non-odorous gases. The problems are compounded by the complicated nature of the organic reactions involved. The industry, however, has made great strides in reducing its air pollution potential. This paper describes the process by which kraft pulp is produced, the sources of pollutants, and the methods presently known for alleviating the air pollution problems. New approaches also are discussed which might prove beneficial in improving air quality in the vicinity of pulp and paper mills. (Author abstract)

02279

J.E. Landry D.H. Longwell

ADVANCES IN AIR POLLUTION CONTROL IN THE PULP AND PAPER INDUSTRY. Tappi 48, (6) 66A-70A, June 1965. (Presented at the Annual Meeting, National Council for Stream Improvement, New York City, Feb. 23, 1965.)

Black liquor oxidation, electrostatic precipitation, secondary scrubbing, lime kiln scrubbers, digester relief and vent gas disposal are covered.

02955

A. B. Walker

ENHANCED SCRUBBING OF BLACK LIQUOR BOILER FUME BY ELECTROSTATIC PRE-AGGLOMERATION: A PILOT PLANT STUDY. J. Air Pollution Control Assoc. 13, (12) 622-7, Dec. 1963. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

From the data and analyses presented, the following conclusions appear justified: The performance of the flooded-disc scrubber is similar to that of the Venturi scrubber on the basis of power input. The performance of the flooded-disc or Venturi scrubber can be predicted on the basis of power input without regard for the geometry of the particular system; the selection of which system is thus dependent upon the most economical configuration from the standpoint of the cost of the various types of power available (i.e., steam, gas pressure, etc.). Electrostatic pre-agglomeration materially affects the performance of inertial impaction scrubbers. The theory that the dominant mechanism of agglomeration in the electrostatic precipitator is collection and resuspension appears to be supported by the data. Electrostatic agglomerators can be designed on the basis of existing precipitator theory provided the conditions for formation of stable agglomerates are met. The conditions for the formation of stable agglomerates are met in the case of the black liquor recovery boiler.

03807L

THE CHLORINE OXIDATION OF SULFUR COMPOUNDS IN DILUTE AQUEOUS SOLUTION. National Council for Stream Improvement, Inc., New York City. (Atmospheric Pollution Technical Bulleting 18.) June 1963. 16 pp.

Oxidation of sulfide in aqueous solution requires between 2 and 3.4 moles of Cl2 per mole of sulfide, depending upon conditions and the fraction of the sulfide oxidized. Oxidation of all the sulfide present requires at least 2.35 moles of Cl2 per mole of sulfide. Sulfate is a major product. Complete oxidation of methyl mercaptan in neutral or acid solutions requires between 2.4 and 3.3 moles of Cl2 per mole of mercaptan. Under basic conditions, methyl mercaptan apparently reacts to form an intermediate which, in turn, appears to oxidized by Cl2 once all the mercaptan has reacted. Formation of the suspected intermediate requires some 1.5 moles of Cl2 per mole of mercaptan, but a total of about 2.6 moles of Cl2 per mole of mercaptan must be added before the first trace of excess Cl2 can be detected. All attempts to identify the products of these reactions failed--probably because the concentrations involved were below the sensitivity limits of the tests used. Oxidation of dimethyl sulfide required 1.8 moles Cl2 per mole of sulfur. Oxidation of dimethyl disulfide required 5.2 moles of Cl2 per mole of disulfide--equivalent to 2.6 moles of Cl2 per mole of sulfur. All of the Cl2 oxidations were rapid enough to be complete before iodine was added. This means that the oxidations of inorganic sulfides and mercaptans required less than one minute and oxidation of the organic sulfides took less than five minutes.

03946

W. Lenz A. Tirado

MEXICAN KRAFT MILL USES OBSERVERS TO CHECK ITS ODOR CONTROL PROGRAM. Paper Trade J. 150, (34) 64, 68, Aug. 1966.

A method is described whereby a Mexican kraft pulp mill is able to evaluate the effectiveness of its odor control program. Persons residing within a given distance of the mill are asked to provide information regarding odors at their homes on a standard form. This information is coordinated with meteorological data and plant activities. Under the assumption that either the blow or the gas relief are the main cause of trouble, a 'relative index' is compiled by dividing the total weekly complaints by the total number of blows for the week. This is used as a measure of odor level and is recorded graphically to illustrate the improvement or decline of conditions.

03975

N. S. Lea E. A. Christoferson

SAVE MONEY BY STOPPING AIR POLLUTION. Chem. Eng. Prog. 61, (11) 89-93, Nov. 1965.

Control methods and equipment used in a bisulfite mill to reduce air pollution from the centing of sulfur dioxide-based blowpit gases are described. The system used was a modified Rosenblad system from Sweden. A detailed description of the system, equipment, economics and efficiencies is presented; schematics of the operating control system are included.

04045

A. A. Tirado, M. V. Guevara, and J. S. Banduni

OXIDATION OF BLACK LIQUOR BY AIR UNDER PRESSURE. J. Air Pollution Control Assoc. 12, (1) 34-8, Jan. 1962. (Presented at the 54th Annual Meeting, Air Pollution Control Association, New York City, June 11-15, 1961.)

It was decided to investigate the oxidation of black liquor by means of air under pressure. A samll reactor was used which consisted of a six-inch pipe about 28 inches long, provided with a diffuser at the bottom. Compressed air was admitted through that diffuser. Liquor and air, at variable quantities, were fed through the bottom, and the products of the reaction escaped through a pressure relief valve on the top of the reactor. The pressure relief valve was adjusted, so that a predetermined pressure was maintained in the reactor, while the temperature of the liquor was varied in order to see the effect of temperature. Liquors at the inlet and outlet of the reactor were titrated only by the Borlew and Pascoe method analysis (potentiometric), as it was known that such method practically determines both mercaptans and sulfieds. The oxidation of black liquor by air at 25 to 75 psig shows definite gains specially regarding the conversion of mercaptans, which are difficult to oxidize in conventional processes as used so far. Liquors at 50 psig and 65 C were well oxidized, provided that air was supplied at a rate of about 2.3 times the theoretical air requirement. This quantity of air is about one-third of the air usually added in conventional procedures at atmospheric pressure. Due to the increased pressure, the total power requirement including pumps, compressed air, etc., in the process being studied, was estimated to be approximately twice of the power consumption in a conventional Trobeck system. However, it is thought that the higher efficiencies obtained in the system under pressure should justify such increased power consumption. The oxidation of black liquors in kraft pulp mills is desirable because of three principal reasons: (a) elimination of malodors, (b) prevention of corrosion, and (c) reduction of sulfur losses. Nevertheless, the oxidized solids are to be burned in a boiler and their heat value should be preserved as much as possible. Thus, the oxidation of organic compounds, including mercaptans, should be limited, so that only those desirable effects are attained. It is believed that the reaction with air at a pressure of 50 psig or so is still mild enough as to perform this limited oxidation.

04773

D. F. Adams

A SURVEY OF EUROPEAN KRAFT MILL ODOR REDUCTION SYSTEMS. TAPPI, 48 TAPPI 48, (5) 83¼A-7A, May 2965. (Presented at the Air Pollution Symposium, 148th National Meeting, American Chemical Society, Chicago, Ill., Aug. 30-Sept. 4, 1964.)

During the spring and summer of 1964, a study was made of selected kraft pulp mill installations in Norway, Sweden, Finland, France, Italy, and Austria. Information was obtained by personal interview with technical personnel in the mills and research workers in institutes and universities. Equipment in eighteen mills was observed and the unique features of these processes reported. The principal methods contributing to odor reduction included incineration, alkaline absorption, heat recovery, black liquor oxidation, and chlorine treatment. (Author abstract modified)

04781

T. T. Collins, Jr.

NEW SYSTEMS PROPOSED FOR KRAFT MILL ODOR CONTROL AND HEAT RECOVERY. Paper Trade J. 149, (22) 34-5, May 31, 1965.

Venturi scrubbing and block liquor oxidation are briefly reviewed. If oxidation is coupled with black liquor soap skimming the combination becomes a profitable proposition for increased soap yield. Using stack gas heat recovery apparatus as a part of the odor control system for the first time makes profitable a combination process for the reduction of kraft pulp mill odors. Heat recovery from stack gases coupled with black liquor oxidation and increased black liquor soap skimmings can play a profitable role in the future odor control requirements of the kraft pulp industry.00

04783

W. H. Buxton and M. W. Lapointe

CHEMICAL RECOVERY AND ODOR ABATEMENT ON A KRAFT RECOVERY FURNACE. TAPPI 48, (5) 112A-3A, May 1965. (Presented at the Pacific Section Meeting, Technical Association of the Pulp and Paper Industry, Longview, Wash., Nov. 18, 1964.)

Air pollution at Western Kraft Corp. in Albany, Ore., has been substantially reduced by establishing uniform recovery furnace control and utilizing secondary stack gas chemical recovery. Using wet gas scrubbers in conjunction with an alkaline shower wash, sodium ion collection efficiencies as high as 50% have been reported Hydrogen sulfide recovery of 90% was obtained during extensive testing. Chemical fallout in general on mill property has been reduced 94%. (Author abstract)

04861

I. B. Douglass

SOME CHEMICAL ASPECTS OF KRAFT ODOR CONTROL. Preprint. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 15, 1967.)

The kraft process, by which more than 60% of all wood pulp made in the U. S. is manufactured creates an air pollution problem by releasing methyl mercaptan, dimethyl sulfide and hydrogen sulfide to the atmosphere. Most of the problem is associated with the emission of gases from the digester, the direct evaporator and the recovery furnace. In this paper the chemistry involved in odor formation, in black liquor oxidation, and in the destruction of malodorous compounds by burning, chlorination and treatment with ozone will be discussed. (Author abstract)

04882L

National Council for Stream Improvement, Inc., New York, N. Y.

STATUS OF PRESENT INVESTIGATIONS AND FUTURE RESEARCH NEEDS IN ATMOSPHERIC POLLUTION CONTROL AT-TBull-29, 13p., June 1966.

The current status of research and technical programs concerning the kraft mill industry is reviewed. The following topics are included: (1) Analytical methods for source-gas sampling and gas-flow measurement, (2) Black liquor oxidation, (3) Absorption and oxidation of sulfur compounds, (4) Particulate emission control, (5) Meteorology and ambient-air- sampling techniques, (6) Cooperative mill service activities, and (7) Staff technical activities.

04887L

National Council for Stream Improvement, New York City.

ABSORPTION OF ODOROUS SULFUR COMPOUNDS IN CHLORINE AND CAUSTIC SOLUTIONS. (Atmospheric Pollution Technical Bulletin No. 23.) Mar. 1965. 23 pp.

The data reported herein cover the complete study on the utility of NaOH and acidic and basic Cl2 solutions as absorbents for odor producing sulfur compounds associated with kraft pulp mills. Absorption of H2S and CH3SH into aqueous solution of Cl2, NaOH, and Cl2 plus sodium NaOH was studied using a 2' diameter absorption column packed with 1/4' Intalox saddles. Absorption rates were noticeably affected by chemical reactions occurring in aqueous Cl2 and hydroxide media. Potentiometric titration methods were used to follow the reactions of Cl2 CH3SH, (CH3)2 S2, (CH3)2S in aqueous Cl2 solutions. The final product of Cl2 oxidation of H2S in aqueous solution is sulfate or collodial sulfur and sulfate. The sulfur-sulfate production ratio requires between 1.5 and 4 moles of Cl2 per mole of sulfide oxidized depending upon pH. CH3SH reacts with one mole of Cl2 forming (CH3)2S2 as a stable intermediate product. Continued Cl2 addition to aqueous acid systems results in formation of a second intermediate, probably dimethyl disulfoxide, and a final product sulfonyl chloride. In basic soltuion only disulfide is formed by the Cl2-mercaptan reaction. (CH3)2S forms sulfoxide upon reaction with Cl2 and further reactions do not appear to occur. The results of the absorption studies indicate that aqueous Cl2 solutions at a pH above 12 are effective absorbents for H2S removal in absorption equipment designed to handle sulfur in suspension. The absorption of CH3SH in aqueous Cl2 solution appeared to be impractical since (CH3)S2 was apparently the only product formed and was stripped from the tower by the gas stream. Hydroxide solution was an effective absorbent for both CH3SH and H2)s when hydroxide to sulfide or mercaptan feed ratios were greater than 1 or 1.8 respectively, and mercaptan absorption rate was twice that for sulfide absorption. (Author summary)

04950

McKean, William T., Jr., Bjorn F. Hrutfiord, K. V. Sarkanen, L. Price, and I. B. Douglas

EFFECT OF KRAFT PULPING CONDITIONS ON THE FORMATION OF METHYL MERCAPTAN AND DIMETHYL SULFIDE. Tappi, 50(8):400-405, Aug. 1968. 23 refs. (Presented in part at the 50th Annual Meeting, Technical Assoc. of the Pulp and Paper Industry, New York, N.Y., Feb. 21-25, 1965.)

Review of the available data on the formation of methyl mercaptan and dimethyl sulfide in kraft pulping allows the estimation of the kinetic characteristics of these reactions for softwood species. The summative rate of methyl mercaptan plus dimethyl sulfide formation is proportional to the initial hydrosulfide concentration in accordance with an SN2 mechanism. The formation of dimethyl sulfide from methyl mercaptan and lignin methoxyl groups appears to be subject to some unusual catalytic effects. Larger amounts of methyl mercaptan and dimethyl sulfide are produced from hardwoods than from softwoods because of a rapid initial demethylation of some labile methoxyl groups. In softwood cooks the formation of dimethyl sulfide can be reduced by short, high-temperature cooks while the temperature effect on mercaptan formation is rather insignificant. More effective reduction in odor formation is possible by lowering the sulfidity and by keeping black liquor recycle at a minimum. (Authors' abstract)

04951

Sarkanen, K. V.

EFFECT OF NEW PROCESS TECHNOLOGY ON AIR POLLUTION POTENTIAL. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: U. S. Public Health Service, National Council for Stream Improvement, and University of Florida. ((1966)), p. 311-334. 19 refs.

An ideal pulping process would selectively remove the major part of lignin (28% in conifers) and extractives of wood leaving the major part of polysaccharide components (69% in conifers) in the pulp. In the long run, sulfide-free alkaline pulping systems may well provide the ultimate solution for kraft mill odor problems. Meanwhile, the odor emission problems of existing kraft mills require more immediate attention. Several methods are already available for the efficient control of odor emissions from digester systems. The chemical recovery, including black liquor evaporation and combustion, leaves, however, much to be desired in terms of efficient odor containment. The carbonation transfer of hydrogen sulfide is proposed as an alternative to black liquor oxidation. Another approach is to stabilize the polysaccharide components to the degree of sufficient survival under the longer reaction periods necessary for delignification by NaOH alone.

04952

T. T. C. Shih, B. F. Hrutfiord, K. V. Sarkanen, and L. N. Johanson

HYDROGEN SULFIDE VAPOR LIQUID EQUILIBRIUM IN AQUEOUS SYSTEMS AS A FUNCTION OF TEMPERATURE AND PH. Preprint. 1966.

The Kraft pulping process continues to increase in importance, both as to number and capacity of mills. Concurrently, requirements are becoming ever more stringent concerning emanation of odors. In this and a subsequent paper, data are presented which are of fundamental importance to an understanding of situations in which hydrogen sulfide or methyl mercaptan may be transferred between liquid and vapor phases. Vapor-liquid equilibrium relationships of hydrogen sulfide in buffered systems are presented as a function of temperature and pH. Measurements were made by a potentiometric titration technique, at temperatures ranging from 80 to 185 C and using solutions buffered to pH values of 2, 5, 6, 7, 8, 10, 12 and 13 at 25 C. Concentrations ranged from 0.00097 to 0.0315 moles of hydrogen sulfide per liter of buffered solution. If the degree of dissociation of hydrogen sulfide is taken into consideration, it is then possible to express vapor pressure of hydrogen sulfide in equation form, in terms of temperature, concentration, and pH of the solution. New values of the first dissociation constant up to 185 C are presented.

04953

T. T. C. Shih, B. F. Hrutfiord, K. V. Sarkanen, and L. N. Johanson

METHYL MERCAPTAN VAPOR LIQUID EQUILIBRIUM IN AQUEOUS SYSTEMS AS A FUNCTION OF TEMPERATURE AND PH. Preprint. 1965.

The vapor-liquid equilibria of methyl mercaptan in buffer solutions were studied as a function of temperature and pH. Measurements were made at temperatures ranging from 80 to 185 C., using solutions buffered to pH values of 7, 8, 10, 12, 13 and 14 at 25 C., and containing from 0.00182 to 0.0451 moles per liter of methyl mercaptan. These measurements also necessitated preliminary kinetic studies of the rate of disproportionation of methyl mercaptan to hydrogen sulfide and dimethyl sulfide in alkaline solutions. An activation energy of 22.4 Kcal/g-mole was found for the reaction in one normal NaOH solution. Small corrections to the methyl mercaptan concentration were required at high concentration levels, as a result of this reaction. Vapor pressure-temperature relationships for 0.01 N methyl mercaptan solution were formulated with pH level as a parameter. Henry's Law was found to be valid for any particular pH and temperature. Henry's Law Constants, the dissociation constant and vaporization equilibrium constants as a function of temperature were calculated from experimental data. The overall expression relating the vapor pressure of methyl mercaptan to its concentration and to hydrogen ion concentration is given for dilute aqueous solutions. (Author abstract)

05001

R. O. Blosser, and H. B. H. Cooper

PARTICULATE MATTER REDUCTION TRENDS IN THE KRAFT INDUSTRY. National Council for System Improvement, Inc., New York City. (Atmospheric Pollution Technical Bulletin No. 32.) Apr. 4, 1967. 26 pp.

A survey of secondary wet scrubbing practices showed that relatively low pressure drop devices may produce a 50 percent to 80 percent reduction in particulate emission from precipitator streams. The percent reduction is somewhat less where these devices are employed behind Venturi recovery units. Removal efficiency was observed to be independent of the type of scrubber used behind precipitators at the inlet loadings observed. Final effluent quality was related directly to scrubber inlet grain loading. Effective scrubbing has been shown to reduce particulate fallout in the area adjacent to mills. Scrubbing may reduce particulate emissions to the atmosphere, but may also reduce the height of plume rise, hence dispersion is reduced and an odor problem may be accentuated. It is difficult to predict that any real benefit in either fallout or total emission is obtained at the low loadings found behind some of the new high efficiency precipitators. This suggests that schemes which assure essentially continuous operation of these units in a good state of repair may be as advantageous as wet scrubbing.

05074

J. L. Clement

MAGNESIUM OXIDE RECOVERY SYSTEM (DESIGN AND PERFORMANCE). TAPPI 49, (8) 127A-34A, Aug. 1966. (Presented at the 20th Engineering Conference, Technical Association of the Pulp and Paper Industry, Minneapolis, Minn., Sept. 12-16, 1965.)

Equipment arrangements are presented to meet the requirements of a magnesia base pulp mill for complete recovery of heat and chemicals from spent sulfite liquor. Several designs of recovery boilers including alternate arrangements and designs of economizers and air heaters provide heat recovery in an integrated system. Boiler design can incorporate auxiliary fuel firing to assure steam production independent of liquor availability. Recovered magnesium oxide is used to remove 98%+SO2 from combustion gases in a venturi absorption system to prepare acid at a concentration required by the pulp mill. The capacity of a recovery system is about twice as large for a low yield dissolving-grade pulp as for a pulp to be used in newsprint furnish.

05091

H. P. Willett

CUTTING AIR POLLUTION CONTROL COSTS. Chem. Eng. Progr. 63, (3) 80-3, Mar. 1967.

The purpose was to present a number of case histories where the cost of air pollution control has been drastically reduced by innovations in the basic process which caused the pollution problem. Exhaust systems for electric furnaces; hoods for basic oxygen furnaces; exhaust systems for gray-iron cupolas; incinerators with waste heat recovery; chemical composting; black liqour oxidation, blowers for sulfuric acid concentrators; and automotive engine operation modification are cited as examples of some of the ways in which relatively inexpensive changes in basic process are cutting the cost of air pollution control.

05408

M. J. Matteson, L. N. Johanson, and J. L. McCarthy

SEKOR II: STEAM STRIPPING OF VOLATILE ORGANIC SUBSTANCES FROM KRAFT PULP MILL EFFLUENT STREAMS. TAPPI 50, (2) 86-91, Feb. 1967.

A pilot plant study has been carried out of the SEKOR process, which consists, in its main application, of the following elements: the continuous steam stripping with reflux of kraft pulp mill effluents to remove volatile organic compounds and the collection of the resultant bottoms and overhead streams to avoid discharging effluent volatile organic compounds into the air; the recovery of an overhead stream of water-immiscible oils; the substantial removal of volatile compounds from the condensate effluents, which reduces the hazard of water pollution should the effluent be discharged into water courses; and the recovery of a bottom stream of condensate water now purified to such a degree that often it may be reused in kraft pulp mill process operations. Experiments demonstrated that hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide were removed to a degree exceeding 95%. Operations were conducted satisfactorily using steam stripping without reflux (SENKOR-A) or with reflux (SEKOR-B). When the SEKOR-B process was used under appropriate conditions, nearly all of the volatile organic compounds were collected in the water-immiscible overhead stream.

05409

B. F. Hrutfiord and J. L. McCarthy

SEKOR I: VOLATILE ORGANIC COMPOUNDS IN KRAFT PULP MILL EFFLUENT STREAMS. TAPPI 50, (2) 82-58 Feb. 1967.

As part of a program of development of a process for stripping aqueous effluents for kraft pulp mill odor reduction (SEKOR), a study has been made of the volatile organic compounds that may be steam-distilled from kraft pulp mill effluent liquors. Some compounds have been isolated and characterized by gas chromatography. The materials studied include an oil isolated from blow gas condensate, an aqueous blow gas condensate, and several crude sulfate turpentines. Compounds identified include hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyldisulfide, methanol, ethanol, acetone, methyl isobutyl ketone, alpha-pinene, beta-pinene, delta 3- carene, camphene, limonene, cineole, and alpha-terpineol. A large number of additional compounds have been detected. Turpentines from a number of sources have been analyzed and compared. (Authors' abstract)

05808

F. E. Murray

REACTIONS OF SULFUROUS AIR POLLUTANTS. ((British Columbia Research Council, Vancouver, Canada)). May 12, 1967. 88 pp.

The object of the work was to generate information on the reactions of methyl mercaptan, methyl sulfide, methyl disulfide and the reaction between hydrogen sulfide and sulfur dioxide - all in the gas phase. It was a further object of the studies to devise methods, using the information gained, for modifying these compounds by chemical reaction to alleviate the odorous air pollution from kraft pulp mills. Reactions in the gas phase were conducted between oxygen and methyl mercaptan, methyl sulfide and methyl disulfide both with and without catalysts. The reaction between hydrogen sulfide and sulfur dioxide in the gas was the subject of a preliminary study. The work done and the apparatus used is described in the following publications which form an Appendix to this report: (1) Gas Phase Oxidation of Methyl Mercaptan, A. C. Harkness and F. E. Murray, Air and Water Pollution, Int. J. v. 10, pp 245-251 (1966); (2) Gas Phase Oxidation of Methyl Sulfide, A. C. Harkness and F. E. Murray, Air and Water Pollution, Int. J.; (3) Method of Analyzing the Effluent from a Microreactor, L. T. Girard and A. C. Harkness; (4) Catalytic Oxidation of Sulfurous Air Pollutants, A. C. Harkness, F. E. Murray and L. T. Girard; and (5) Application is being prepared for patent coverage on the catalytic oxidation of the organic sulfides. From the results on catalytic oxidation, a large-scale experimental reactor packed with iron shot was assembled and studies are continuing at a local pulp mill. It appears to be a very promising approach to the oxidation of organic sulfur compounds in the gas phase. One of the principal advantages seems to be that no explosions or tendency to explosions have occurred in the catalytic reactor.

05880

V. P. Owens

CONSIDERATIONS FOR FUTURE RECOVERY UNITS IN MEXICAN AND LATIN AMERICAN ALKALINE PULPING MILLS. Combustion 38 (5), 38-44 (Nov. 1966). (Presented at the Sixth Annual Meeting, Asocion Mexicana de Tecnicos de las Industrias de Celulosa y del Papel A. C., Mexico City, Mex., May 24-28, 1966.)

Air pollution is a major problem in recovery unit operation because the recovery unit produces the largest volume of gases discharged to atmosphere. For many years electrostatic precipitators have been installed after recovery units to remove the chemical fume in the gases. The gas is heavily laden with submicron size particles which is condensed sodium vapor formed in the furnace. Several mills are working with venturi-scrubber installations to improve collection efficienceies in operation. Oxidation of black liquor is becoming a 'must' for mills that hope to reduce the odor nuisance to a tolerable limit. In the future, efforts will be concentrated on the analysis of sulfur compounds in the flue gases. Good kraft-recovery-furnace operation demands a deficiency of air through the primary-air ports for good reduction performance. Under these conditions hydrogen sulfide is formed in the lower furnace. Sulfur oxides formed in combustion of a black liquor will react with the sodium oxide to form salt cake and prevent sulfur loss from the furnace in this form. Direct- contact evaporators, either the cascade or the cyclonic type use the flue gases for evaporation of the water in the liquor to increase concentration from the approximately 50 per cent level to 60-70 per cent dry solids. This is the prime source of odor when black liquor is not oxidized before direct- contact evaporation. Oxidation converts the sodium sulfite to a stable form, usually sodium thiosulfate. Direct-contact evaporators can be removed by designing multiple-effect evaporators for 60 per cent dry solids for feed directly to the furnace.

06106

R. H. Wright

NEW WORK IN KRAFT MILL ODOR CONTROL. (J. Air Pollution Control Assoc.) 13 (3), 101-4, 136 (Mar. 1963). (Presented at the 55th Annual Meeting, Air Pollution Control Association, Chicago, Ill., May 20-24, 1962.)

Procedures for the control of odor in the kraft pulping process are reviewed. The theory behind black liquor oxidation is that when the hot liquor is brought in contact with air, the sodium sulfide is oxidized to sodium thiosulfate and the methyl mercaptan is converted to dimethyl disulfide, resulting in reduction of the more odiferous compounds. If the oxidation tower is situated so that the black liquor passes through it before going to the multiple-effect evaporator the odor released is eliminated or very greatly reduced. Thus, in a mill using black liquor oxidation, the most serious remaining sources of odor are, in order of decreasing importance, the recovery furnace, the direct contact evaporator, and the air exhausting from the oxidation towers. With a properly designed and operated furnace the flue gas should contain no significant amounts of H2S or other reduced sulfur compounds. In principle, a sufficiently complete prior oxidation of the black liquor will prevent the furnace gases from picking up any malodors in the direct contact evaporator, apart from substances like dimethyl sulfide which are not acidic and not retained by alkali. One may be forced to carry out the black liquor oxidation in two stages, using a partial oxidation of the weak liquor and finishing off the reaction after the liquor has been partially evaporated. An alternative is to do away with the direct contact evaporator entirely. The elimination of the direct contact evaporators can confer an over-all operating benefit in the form of heat economy, but at the cost of a substantial increase in complexity. The balance of advantage from this has to be worked out by each mill for itself. In the oxidation tower exhaust gas process a two-stage process has been developed for the absorption and oxidation of the malodorous substances in the oxidation tower exhaust gas, using a gas-liquid reactor. The gases are first exposed to chlorine solutions of low pH so as to absorb and oxidize the sulfur compounds to innocuous products. Then a solution of pH about 8 is used to absorb any residual chlorine or acid products of the oxidation. Kraft mill odor control measures are still by no means complete or fully effective. Black liquor oxidation is not a complete answer, though it would be difficult to imagine an effective control system that did not include it.

06343

Erdman, Andrew, Jr.

APPLICATION OF FLUIDIZED BED PROCESSING TO SPENT SULFITE LIQUOR COMBUSTION. TAPPI, 50(6): 110A-112A, June 1967. 3 refs. (Presented at the 20th Alkaline Pulping Conference, Technical Assoc. of the Pulp and Paper Industry, Richmond, Va., Sept. 13-16, 1966.)

The combustion system of neutral sulfite semichemical (NSSC) spent liquor comprises two parts. The first is the evaporator section, where weak liquor at 14% solids is concentrated in two steps to 41% solids to form an autogenous feed for the combustion reactor. The second part is the combustion unit, which produces oxidized pellets of inorganic ash consisting of sodium sulfate and sodium carbonate. The entire combustion system is fully instrumented for minimum labor requirements. The basic control points that are automated are; liquor concentration from the multiple effect evaporator, liquor concentration in the venturi evaporator-scrubber, combustion bed temperature, combustion fluid bed level and cooling fluid bed level. This spent liquor combustion system is not limited to the disposal of NSSC spent liquor. Other pulping waste liquors lend themselves to equally effective disposal. However, operating conditions with respect to combustion temperatures and minor flow sheet modifications change for the various bases, as do the solid and gaseous products. The differences in combustion between various bases are briefly summarized.

06859

I. S. Shah

NEW FLUE-GAS SCRUBBING SYSTEM REDUCES AIR POLLUTION. Chem. Eng., 74(7):84-86, March 27, 1967.

A new two-stage scrubbing system is described which consists of evaporator, scrubber, separator and cooling tower in which 99% cleaner and 500-600F cooler. Two oxidation systems are utilized, one for weak black liquor and the other for strong black liquor. The latter is installed immediately after the multiple effect evaporator. Air oxidation of black liquor decreases the loss of hydrogen sulfide because oxygen converts Na2S to less volatile forms that minimize release of sulfur-bearing gases.

07415

Blosser, R. O., and H. B. H. Cooper, Jr.

TRENDS IN REDUCTION OF SUSPENDED SOLIDS IN KRAFT MILL STACK. Paper Trade J., 151(11):46-51, Mar. 13, 1967. 6 refs.

A survey of secondary wet scrubbing practices showed that relatively low pressure drop devices may produce a 50 per cent 3 80 per cent reduction in particulate emission from precipitator streams. The per cent reduction is somewhat less where these devices are employed behind Venturi recovery units. Removal efficiency was observed to be independent of the type of scrubber used behind precipitators at the inlet loadings observed. Final effluent quality was related directly to scrubber inlet grain loading. Effective scrubbing has been shown to reduce particulate fallout in the area adjacent to mills. Scrubbing may reduce particulate emissions to the atmosphere, but may also reduce the height of plume rise, hence dispersion is reduced and an odor problem may be accentuated. It is difficult to predict that any real benefit in either fallout or total emission is obtained at the low loadings found behind some of the new high efficiency precipitators. This suggests that schemes which assure essentially continuous operations of these units in a good state of repair may be as advantageous as wet scrubbing. (Authors' summary)

07433

E. L. Smith

SULFITE PULPING AND POLLUTION CONTROL. Combustion, 38(12): 42-44, June 1967.

Among the various schemes which have been proposed for disposing of sulfite pulping waste liquors, the most straightforward and least expensive method available today consists of burning the organic portion of the liquor. An economic evaluation of the combustion system of waste disposal is presented, together with a study of capital investment costs for a typical installation. The most logical approach to disposal of waste sulfite liquor lies in burning it at maximum efficiency and with maximum heat recovery. The disposal plant can be paid for out of the savings in purchased fuel.

07434

E. Thomas, S. Broaddus, E. W. Ransdell

AIR POLLUTION ABATEMENT AT S. D. WARREN'S KRAFT MILL IN WESTBROOK, ME. Tappi, 50(8):81A, Aug. 1968. (Presented at the 52nd Annual Meeting, Technical Association of the Pulp and Paper Industry, New York City, Feb. 19-23, 1968.)

Sources of gas emission in a kraft mill were studied and corrective equipment was installed. A system was developed in which digester blow gases are passed through primary and secondary deodorizing scrubbers, utilizing the chlorination stage effluent. As backup, weak hypo bleach can be added to the secondary unit. Noncondensable digester relief gases are burned in the lime kiln. Oxidation control instruments have been installed on the two recovery boilers to ensure complete combustion. Number 1 recovery boiler stack has a Cottrell precipitator, and a venturi scrubber is on no. 2. Both recovery boilers have scrubbers on their smelt tank vents. Black liquor is presently oxidized in a Trobeck-Lundberg- Tomlison oxidation tower before passing to the evaporators. Chemical tests are performed daily to determine the efficiency of black liquor oxidation. Periodic surveys are conducted on all suspected sources of air pollution ot determine the effectiveness of this abatement program.

07769

Howard, W. C.

A NEW AND ECONOMIC SOLUTION TO THE PROBLEMS OF STREAM AND AIR POLLUTION. Norsk Skogind. (Norway), 21(4):133-139, April 1967. 2 refs. (Presented at the Papirindustriens Tekniske Forenings Meeting, Oslo, Norway, Dec. 7, 1966.)

The disposal of polluting solids by means of the fluid-bed reactor is discussed. The fluid-bed reactor is the most efficient combustion system developed thus far. Material is introduced in finely divided form, presenting relatively large surface area for exposure to the reacting gases. Heat transfer is excellent because of extreme particle proximity. Liquids of low concentration burn readily because of countercurrent evaporation which takes place during the liquid particle's descent to the fluid bed. The fluid bed reactor is relatively compact, occupying less area than other conventional processing units with comparable capacity. Operations of chemical recovery systems, the kraft overload relief system, and incineration systems utilizing the fluid bed reactor as the primary processing unit are described. In addition to accomplishing a system for disposing of objectionable effluent materials from plants, the fluid-bed is a practical tool for the reclamation of chemicals where practical. Other applications include disposal of pickling wastes from the metals industries, municipal sewage sludge disposal, food processing plant discards and effluent waste materials from the chemical and petroleum processing plants.

07974

Dehaas, G. G. and L. C. Amos

RECOVERY SYSTEMS FOR MIXED KRAFT AND SULFITE LIQUORS. TAPPI, 50(3):75A-78A, March 1967. 6 refs.

Sulfite pulping processes can be incorporated into kraft (sulfate process) mills without the need for separate expensive recovery facilities by mixing sulfite spent liquor with the kraft spent liquor. &rocess and equipment are described for recovering sulfite cooking liquor from mixed liquors with minor additions to the kraft recovery system. Green liquor is contacted with CO2 (lime kiln gas) to remove sulfur as H2S, which is burned to SO2 or partially oxidized to elemental sulfur by an aqueous-phase catalyst. Sodium recovery, as sodium carbonate obtained by removing all sulfide from green liquor, requires efficient equipment. (Authors' abstract)

08360

Hansen, G. A.

ODOR AND FALLOUT CONTROL IN A KRAFT PULP MILL. J. Air Pollution Control Assoc., 12(9):409-414, Sept. 1962. 4 refs. (Presented at the 55th Annual Meeting of APCA, Sheraton-Chicago Hotel, Chicago, Ill., May 20-24, 1962.)

A kraft mill air pollution problem exists in two phases: The general odor-control systems currently being used in two Weyerhaeuser kraft mills are described. The systems are practical from a cost standpoint and are reasonably effective. These systems are based on collecting and destroying the malodorous compounds by burning or by chlorine oxidation in the case of digester blow and relief gases. In the recovery furnaces and evaporators, release of odors is prevented through black liquor oxidation and by carrying excess oxygen in the recovery furnace flue gas. Flyash at the Everett Kraft Mill has been reduced effectively by combining lime kiln and recovery furnace flue gases before passing them through a modified Venturi scrubber. Particulate matter discharged, as measured by sodium concentration in the flue gas at the top of the stack, has been reduced over 90%. This is confirmed by fallout samples taken in the vicinity of the mill itself. The installation of the systems described has reduced complaints to the vanishing point. ASM

08361

Hartler, Nils

RECENT EXPERIENCES IN POLYSULFIDE COOKING. TAPPI, 50(3):156-160, March 1967. 18 refs. (Presented at the 20th Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Richmond, Va., Sept. 13-16, 1966.)

A changeover to polysulfide pulping in a kraft mill requires the introduction of new techniques or modifications of those presently existing. Preparation of the cooking liquor is preferably done by dissolving sulfur in white liquor from the recovery cycle. The dissolution process is considered from a theoretical as well as a practical chemical engineering viewpoint. The procedure of adding sulfur to the digester together with the wood is compared that of separate dissolution. In order to fully control the cook, a knowledge of two parameters, effective alkali and excess sulfur content, is sufficient. Some procedures for the determination of the latter are described, and preference is given for the redox method. Polysulfide does not affect the removal of lignin to any appreciable extent. It is shown that, with no extra alkali added fairly small amounts of carbohydrate polymers are dissolved in the cooking liquor. The achieved stabilization caused by oxidation is probably not as complete as in the case of reduced carbohydrates. The net effect on pulp yield is, however, very much the same as in the case of borohydride cooking. This build-up of sulfide is probably the cause of the higher odor level. The differences between the quality of polysulfide and kraft pulp are summarized, and the implications are that if the papermaker places the main emphasis on beatability and stock freeness, polysulfide cooking would be a very attractive alternative to conventional kraft cooking. If, however, tear factor is an important strength consideration, polysulfide cooking becomes less attractive. AA

08364

Landry, J. E.

BLACK LIQUOR OXIDATION PRACTICE AND DEVELOPMENT--A CRITICAL REVIEW. TAPPI, 46(12):766-772, Dec. 1963. 22 refs.

The progress in black liquor oxidation research, development, and application is summarized, along with experimental data from laboratory research and mill operations. In the kraft recovery process, oxidation of the black liquor prior to evaporation and burning leads to a considerable reduction in sulfur loss to the atmosphere and improved chemical recovery. For these reasons, research and development on oxidation processes during the last five years have proceeded rapidly and kraft mills in this country have been quick in applying the results of these investigations, despite the fact that problems still remain to be solved under some conditions of operation. (Author's abstract, modified)

08365

Howard G. Maahs, Lennart N. Johanson, Joseph L. McCarthy

SEKOR III: PRELIMINARY ENGINEERING DESIGN AND COST ESTIMATES FOR STEAM STRIPPING KRAFT PULP MILL EFFLUENTS. TAPPI, 50(6):270-275, June 1967. 9 refs.

An illustrative, preliminary engineering design and cost estimate has been carried out relative to the SEKOR-B (refluxed column) process. As a basis for such calculations, experimental determinations have been made of vapor-liquid equilibrium constants for the sulfur- containing components. CH3SH, (CH3)2S, and (CH3)2S2 in dilute concentration in water at 1 atm total pressure, and, also, for the substances limonene, alphapinene, and alpha-terpineol, which are major constituents of the recovered volatile oil. It is shown that all substances are of higher volatility than water and may be steam-stripped, and that alpha-terpineol and dimethyl disulfide are the most difficult to strip from water. The optimum feed/steam ratio, reflux rate, and number of stages required to strip H2S and the above components from condensates of a 400 ton/day kraft pulp mill were calculated. To reduce the concentration of

(CH3)2S2 to 1% of its feed concentration, capital cost was estimated to be $51,500 to treat 1,000,000 lb/day of blow and relief gas condensates. If amortized over a 5-year period, this capital cost together with operating costs is estimated to result in a total cost per ton of dry pulp of $0.25/ton for 5 years and of $0.13/ton thereafter. If the sale of recovered crude SEKOR oils at $0.04/lb is feasible, and if hot process water is valued at $0.03/1000 gal, the above costs for treating blow and relief gas condensates are estimated to approximately $0.07/ton pulp. The cost and design bases used are described in some detail to allow potential users to undertake similar calculations compatible with local conditions, and, thus, to obtain alternate costs per ton of pulp if so desired. AAM

08366

PROGRESS IN ALKALINE PULPING--1965. The Institute of Paper Chemistry. Tappi, 49(6):108A-120A, June 1966. 264 refs.

Technical and topical literature reporting progress in alkaline pulping, abstracted in the Abstract Buleetin of The Institute of Paper Chemistry during the calendar year 1965, is reviewed. Documents from fourteen countries are included. The bibliography lists tw-hundred-sixty-four references.

09047

Murray, J. S.

SCRUBBING KRAFT RECOVERY FURNACE GASES. TAPPI, 43(11):899-903, Nov. 1960. 1 ref.

The Everett kraft mill experimented with various recovery furnace flue gas pilot-plant scrubbers to determine if the fly ash remaining after an electrical precipitator could be removed successfully. Results indicated that a spray-nozzle, venturi-throat scrubber would remove about 90% of the sodium salts from the flue gas. A full-size, stainless steel scrubber was installed and tested. Results indicated that the plant scale unit normally removes about 90% of the fly ash. (Author's abstract, modified)

09048

Hawkins, Gerald

BLACK LIQUOR OXIDATION AT CHAMPION'S TEXAS MILL HAS UNUSUAL TWIST. Paper Trade J., 146(10):38-39, March 5, 1962.

The present oxidizer at Champion's Texas Division is unusual in that it oxidizes heavy liquor (44 per cent solids) instead of weak liquor. Air flow is introduced from a blower delivering 5,970 c.f.m., running 720 r.p.m. The air is discharged near the top of the cone bottom by means of an air sparger which allows the air to come into intimate contact with the downward flowing liquor as the air travels upward, exhausting through a cyclone separator. The cyclone allows any entrained liquor to separate from the air and return to the oxidation tower. Retention time of the liquor in the oxidation tower is approximately 150 minutes. The stack losses of sulphur as H2S are greatly reduced with the oxidizer running. The losses of sulphur as SO2, however, show a slight increase.

09356

NEW DEVELOPMENTS IN INDUSTRY FOR POLLUTION CONTROL. Air Eng., 10(2):20, Feb. 1968.

A fiber glass reinforced plastic (RP) gas scrubbing tower has successfully replaced a 316 stainless steel structure that corroded at a wood pulp mill near San Francisco. Chemical vapors such as sodium chloride, sodium sulphate, sodium carbonate, sodium sulphite, sodium sulphide, sodium dioxide and hydrogen peroxide were the corrosive influences that had to be considered. The RP structure is self-supporting, and can resist temperatures in the 300 deg. F. range.

09508

Harding, C. I.

SOURCE REDUCTION IN THE PULPING INDUSTRY. Proc. Fifth Ann. Vanderbilt Unit. Sanitary and Water Resources Engineering Conf., p. 192-204, June 2-3, 1966. 6 refs.

It is possible at this time to drastically reduce the normal odorous emissions from kraft mills. Few mills, if any, have utlized all of the possible control steps, many of which are discussed. Most new mills are being designed with reduction of atmospheric emissions as a primary aim. Recent and current research efforts are pointing the way to better control of mill emissions by reducing the quantity of pollutants formed during the pulping and recovery processes. (Author's summary, modified)

09655

Major, William D.

VARIATIONS IN PULPING PRACTICES WHICH MAY EFFECT EMISSIONS. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 265-281. 8 refs.

Emissions from a kraft mill can be divided into two categories, gaseous and particulate. Malodorous emissions are subject to far less control and precision of analysis than particulate emissions. The magnitude of loss is more sensitive to operating variables, the chemistry is more complicated and the sources are more numerous. This discussion is concerned with the effect of operating variables on gaseous sulfur losses. Evidence is given which indicates that the wood species has a definite effect on the odor produced during kraft pulping. Cooking variables include: sulfidity of the white liquor, cooking time and cooking temperature. More recent cooking variables are: continuous vs. batch digestion, and the use of black liquor dilution in the digester as a means of controlling the liquor -to-wood ratio. Multiple-effect evaporators are the second largest source of gaseous sulfur losses in the process. The high vacuums set up by condensers result in the release of low vapor pressure sulfur compounds. Operating variables in direct contact evaporation are: black liquor pH, sodium sulfide concentration, and per cent CO2 in the flue gas. Dust losses from the recovery furnace are controlled with either a venturi scrubber or an electrostatic precipitator. Operating variables which influence the efficiencies of these two units are overloading, and the temperature of the flue gas. The key to the effect of operating variables on emissions from a kraft pulp mill is to recognize the degree to which the various steps in the kraft process are interrelated, especially in the case of gaseous sulfur losses.

09656

Lindberg, Siguard

REDUCTION OF AIR AND WATER POLLUTANTS AT THE SKOGHALL MILLS. In: Proceedings of the International Conference on Atmospher- ic Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Pub- lic Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 335-346.

Over the years several measures have been taken to destroy or to reduce air and water pollutants from the sulfate mill in Skoghall, Sweden. To identify the emission points, the actual departments at the sulfate mill are described. The primary sources of odor at the mill, and measures taken to dispose of them are shown in a table. A detailed discussion, with the aid of illustrations, describes fully the measures taken to control the odors at each point. It is concluded that the measures to improve the factory surroundings with regard to malodorous pollutants had the intended result, and at a reasonable cost.

09661

Lindberg, Sigvard

COMBUSTION OF MALODOROUS GASES FROM ALKALINE PULP COOKING. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 370-372.

This paper describes an invention to get rid of malodorous air and water pollutants by combustion of gases from the cooking in a continuous digester of alkaline pulp, especially sulfate pulp. The aim of this invention is to destroy both air and water pollutants in one single operation. The application to continuous cooking is demonstrated with a flow diagram.

09733

Shah, I. S. and Louis Mason

NEW TWO-STAGE EVAPORATOR-SCRUBBER SYSTEM FOR EFFICIENT RECOVERY OF HEAT, FUME, AND DUST FROM RECOVERY BOILERS. TAPPI, 50(10):27A- Conference of the Technical Association of the Pulp and Paper Industry, Boston, Mass., Oct. 31-Nov. 3, 1966.)

In recent years, Federal, State, and local authoritities have enacted laws and regulations to reduce the quantities of air pol- lutants. This has created a necessity for the pulp and paper in- dustry to improve overall collection and odor removal efficiencies. Presently available equipment, because of some inherent design problems is not able to meet these new requirements. This has led to the development of a two-stage evaporator-scrubber system, which offers almost all the advantages and eliminates most of the dis- avantages of existing systems. Secondary scrubbing systems have been developed to enable lpulp mills to improve the overall dust collection and odor removal efficiencies of their existing systems. This paper describes in detail the history of development and operating characteristics of the two-stage evaporator-scrubber sys- tem and of the secondary scrubbing systems. A new improved S-F type venturi scrubber, as applied successfully in the pulp and paper industry, is also described. (Authors' abstract)

09933

Arhippainen, Bengt, and E. Norman Westerberg

KRAFT ODOR CONTROL—ITS EFFECT ON MILL OPERATING PARAMETERS AND COSTS. Pulp Paper Mag. Can. (Gardenvale), 69(8):65-70, April 19, 1968. 9 refs.

Existing knowledge on kraft odor control is reviewed from a Scandinavian point of view. The ways a kraft odor control system may affect the mill environment and mill processing are briefly discussed. Little is known about the effect of the odor upon people, their psychology, and their attitudes. Furthermore, the performance of the recovery unit and the liquor oxidation system, if direct contact (DC) evaporation is used, are critical to the manintenance of low odor levels most of the time. The recovery boiler system with no DC evaporator, commonly used in Scandinavia, is discussed in some detail. Operating costs for this system are compared with those for a system with a DC evaporator, both with and without additional odor control equipment. For typical Finnish cost conditions, the system without the DC evaporator is slightly favored. Thus, with respect to odor control and costing, the recovery boiler system without DC evaporator may prove to be very competitive in many North American locations.

10001

Shah, I. S.

NEW EVAPORATOR-SCRUBBER SYSTEMS IMPROVE KRAFT RECOVERY PROCESS. Paper Trade J., 152(12):58-64, March 18, 1968.

In the two-stage evaporator-scrubber system the two functions, evaporation and scrubbing, are performed separately in two stages: the first stage a low pressure drop evaporator and the second stage a scrubber. The experimental work done at two pulp mill sites established that the two-stage system provides potimum thermal and dust collection efficiencies as well as flexibility and odor reducing capacity. The design variables and operating data for the two-stage and single-stage systems are presented.

10106

Wong, A.

EXPERIENCE AT ELK FALLS COMPANY LIMITED WITH RECOVERY GAS SCRUB- BING. Pulp Paper Mag. Can. (Gardenvale), 69(9):61-62, May 3, 1968.

The Elk Falls Division, pulp and paper mill of Crown Zellerbach Canada Limited, is located approximately four miles north of Campbe River, B.C. This community of about 8,000 people is supported large by primary and secondary forest industries, but it is also the cent of a very active tourist industry. As an integral part of the air pollution control program at Elk Falls, a multiple-venturi gas scrubber was installed to remove particulate matter from recovery flue gases. This scrubber is operated in conjunction with other du emission control equipment: three cyclone evaporators and two electrostatic precipitators. Costs, to date, include about 41 million for the recovery gas scrubber, about 4670,000 for installation of the scrubber and auxiliary equipment, and 4170,000 for alteration of existing facilities. Corrosion is an unsolved problem and maintenance costs are not available. After two months' operation, the steel and stainless steel sections were corroded through. Test measures to deal with corrosion are described; fiberglass venturi throats appear to resist corrosion and reinforce bisphenolic resin and Heresite (phenolic resin) coatings were found to resist corrosion for six months. The combined system, in effect, removes about 995 of the dust emitted from the recovery furnaces. The scrubber unit, being the first of its kind in British Columbia, has been in operation since early 1965.

10268

Vegeby, A.

HOT WATER FROM RECOVERY BOILER STACK GAS: SF SCRUBBER-MODO SYSTEMS. Pulp Paper Mag. Can., 69(9):68-74, May 3, 1968.

The latent heat in the stack gas represents a heat loss which cannot be economically recovered in the boiler. The heating surfaces would be too expensive, and also the draught losses would increase. The investment and operation costs are not compensated by the gain in heat. In plants where there is a demand for hot water, flue gas scrubbers have been used to recover the stack gas loss. Previously, heat exchangers have been used to get clean hot water. The heat exchangers represent a large part of the investment and have also caused problem with scaling. A new design has been developed, the SF Scrubber-MODO System, with which clean hot water is produced in direct contact between the flue gas and the water. This has been made possible by washing the flue gas clean from soot and dust before entering the heat recovery stages. A typical scrubber reduces flue gas sulfur content from 140 lb./hr. after direct contact evaporation to 15 lb./hr. after passing through the washing section. The advantages of this system are: higher temperature for the hot water, greater heat recovery from the flue gases, and lower investment cost. The system, introduced in 1965, in Scandinavia, has made recovery of heat from flue gas more economic and attractive than it has been before.

10277

Blosser, R. O. and H. B. H. Cooper, Jr.

TRENDS IN ATMOSPHERIC PARTICULATE MATTER REDUCTION IN THE KRAFT INDUSTRY. TAPPI, 51(5):73A-77A, May 1968. 6 refs.

A survey of secondary wet scrubbing practices showed that relatively low-pressure-drop devices may produce a 50-80% reduction in particulate emission from precipitator streams. The per cent reduction is somewhat less when these devices are employed downsteam of venturi recovery units. Removal efficiency was observed to be independent of the type of scrubber used at the particulate concentrations in gas streams following precipitators. Final effluent quality was related directly to scrubber inlet particulate concentration. Effective scrubbing has been shown to reduce particulate fallout in the area adjacent to mills. Scrubbing may reduce particulate emissions to the atmosphere, but may also reduce the height of plume rise, hence dispersion is reduced and an odor problem may be accentuated. The principal benefits of secondary scrubbing have been upgrading of effluent quality and the assurance of an effluent of reasonably uniform quality. (Authors' summary)

10366

Alferova, L. A. and G. A. Titova

OXIDIZING SODIUM SULFIDE AND SODIUM MERCAPTIDE IN BLACK LIQUOR. ((Okisleniye sul'fida i merkaptida natriya v chernom shcheloke.)) Text in Russian. Bumazhn. Prom. (Moscow), 10:5-6, Oct. 1966.

This paper is directed toward sulfate cellulose production, in which the regeneration of black liquor creates waste waters and gases whose offensive odors are traceable to their containing hydrogen sulfide and methylmercaptan (MMC) and their salts, odors which can be destroyed by oxidation. The mechanics of the oxidation process are discussed in detail, particularly with respect to oxidation rate. It is concluded that the reactions are kinetic and their rate is a function of temperature and the size of the free-reactant surface; that an acid-base catalysis occurs (whose character is described), and that in aqueous solutions of MMC a nucleophile reaction is generated which leads to formation of methanol and hydrogen sulfide; and that oxidation should be performed with an evolved phase-contact surface, preferably in atomizers at 80-100 Degrees C. and 4-6 (max. 10) kg./sq cm. The reduction process is described.

10578

Banciu, I.

DETERMINATION OF SODIUM SALT LOSSES IN THE RECOVERY BOILER OF A SULFATE PULP MILL. (Determinarea pierderilor de saruri sodice in gazele evacuate la cosul cazanului de regenerare intr-o fabrica de celuloza sulfat.) Text in Romanian. Celuloza Hirtie (Bucharest), 15(7): 253-257, 1966. 5 refs.

In a sulfate pulp mill, alkaline salts are carried away in the flue gases. An electrofilter is described which was installed to prevent the dispersion of these salts into the atmosphere. Efficiency of this filter was determined by a dry and a wet method; the wet method proved simpler and more durable. Equipment used in the wet method is described (sampler, micromanometer, Pitot tube, rotameter, vacuum pump, refrigerant, drier, and industrial thermometer). From tabulated data collected following an analysis of gases and dusts before and after passage through the electofilter, it is determined that the sodium salt losses can be successfully limited by use of this method.

10659

Blosser, Russell O. and HallB. H. Cooper, Jr.

SECONDARY SCRUBBING OF KRAFT RECOVERY STACK GASES. PREPRINT, Oregon State Univ., Corvallis, Engineering Experiment Station, 11p., 1968. 6 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68 -129).

A survey of secondary wet scrubbing practices showed that relatively low-pressure-drop devices may produce a 50-80% reduction in particulate emissions from stack gases which have already passed through an electrostatic precipitator. The per cent reduction is somewhat less when these devices are employed downstream of venturi recovery units. Final effluent quality was related directly to scrubber inlet particulate concentration. Effective scrubbing has been shown to reduce particulate fallout in the area adjacent to pulp mills. Scrubbing may reduce particulate emissions to the atmosphere, but may also reduce the height of plume rise, hence dispersion is reduced and an odor problem may be accentuated. The principal benefits of secondary scrubbing have been upgrading of effluent quality and the assurance of an effluent of reasonably uniform quality.

10758

Kihlman, Erik, (ed.)

RECOVERY OF PULPING CHEMICALS EXPLORED IN DEPTH AT HELSINKI. Apaper Trade J., 152(28):38-47, July 8, 1968.

The recovery of paper pulping chemicals by several processes is explored in depth. Basic knowledge of the recovery process, practical experience of the recovery process in industrial use, and processes under development are included. Emphasis is placed on sulfite pulping. Principles, designs, and experiences with the following systems are presented: the Dorr-Oliver FluoSolids liquor combustion process designed around a fluid bed burner; the electrodialysis membrane (BALC) process; direct carbonation of smelt (MRC) process; the Stora process for chemical conversion of sodium - base liquors; and the Sivola-Lurgi process for NSSC (neutral sulfite semi-chemical) liquors. Detailed consideration is also given to the effects of the recovery of bleach plant effluents on kraft recovery processes, the absorption and desorption of gases during green liquor carbonation, and a simple integrated liquor preparation system.

10765

Rice, James W., and Necmi Sanyer

SODIUM SULFITE RECOVERY BY DIRECT OXIDATION OF SMELT. TAPPI, 51(7):321-327, July 1968.

Smelts from an NSSC and a draft recovery furnace were cooled, crushed, and contracted with humid air in a continuous reactor to oxidize the sodium sulfide to sodium sulfite. Under optimum temperature and humidity conditions and with continuous size reductions by mechanical attrition, the reaction was rapid and selective. The yield of sulfite was more than 80% with mill smelts and more than 90% with synthetic smelts; this justifies further development of this scheme as a basis for neutral and alkaline sulfite chemical recovery. Direct oxidation is particularly attractive for an NSSC operation integrated with the recovery system of a kraft mill. A partial smelt oxidation suitable as a possible polysulfide recovery scheme was also proposed. (Authors' abstract)

10994

Owens, V. P.

TRENDS IN ODOR ABATEMENT FROM KRAFT MILL RECOVERY UNITS. Paper Trade J., 152(33):52-54, Aug. 12, 1968.

The chemical recovery process used in the alkaline pulping industry produces two types of pollutants - particulate matter and malodorous compounds. Wet scrubbing of the particulate matter emitted from the lime kiln stack and collection of particulate matter from the recovery unit stack by electrostatic precipitators in better than 99% collection efficiency. The control of the malodorous compounds has been more difficult. Recovery units designed without flue gas direct-contact evaporation of black liquor are now available, and when properly operated will efficiently complete combustion so that the quantities of sulfur compounds delivered to the stack will be below the minimum detectable limits at ground level. Mills having recovery units with flue gas direct-contact evaporators and efficient oxidation systems have reduced odors as much as 98% as compared with the same unit burning nonoxidized liquors.

11008

Shah, I. S.

AIR POLLUTION. PULP PLANT POLLUTION CONTROL. Chem. Eng. Progr. 64(9):66-77, Sept. 1968.

In Kraft process, chemicals in the form of solids, mists, odorous and nonodorous gases are being emitted to the atmosphere. The source of emission, the theoretical explanation for the emissions, and the various processes and equipment used to reduce the chemical and heat losses are discussed in detail.

11009

Shah, I. S. and Wayne D. Stephenson

WEAK BLACK LIQUOR OXIDATION SYSTEM: ITS OPERATION AND PERFORMANCE. TAPPI, 51(9):87A-94A, Sept. 1968.

After a thorough analysis of the advantages of weak and strong black liquor oxidation and after an evaluation of weak black liquor oxidation in a pilot plant (capable of handling 100 gal/min of liquor equivalent to 50 tons/day of pulp production), a full-scale weal black liquor oxidation system was installed. The system is designed to handle 400 gal/min of weak black liquor at 16-17% solids concentration and 4.0-6.0 g/liter of sodium sulfide content. The wood furnish is a mixture of pine and hardwood, with pine content varying to a maximum of 60%. The commercial system has successfully operated since startup and provides essentially 100% oxidation efficiency, even with variations in liquor flow and sodium sulfide content from 300 to 475 gal/min and 2.3 to 6.6 g/liter, respectively. The total operating power, including fan, pump, and foam breakers is less than 100 hp. The extensive and stable foam that is formed during oxidation is efficiently handled and causes no operating problems. As a result of the oxidation of weak black liquor, the sulfidities of green and white liquors are raised from 18.2 to 27.1% and 22.6 to 27.9%, respectively. The total lime requirement is reduced by 0.085 lb of lime per gal/min of green liquor, a 15.4% reduction. The amount of hydrogen sulfide leaving the recovery furnace stack is reduced by 98.5%. The biochemical oxygen demand of the multiple effect evaporator condensate is reduced by 27% and the pH raised from 6.5 to 9.0, thus making the 175 gal/min of the evaporator condensate suirable for reuse in the pulp mill. Overall, a significant reduction in odor and chemical loss is achieved, as a direct result of the weak black liquor oxidation system. (Authors' abstract)

11150

C. I. Harding and S. F. Galeano

USING WEAK BLACK LIQUOR FOR SULFUR DIOXIDE REMOVAL AND RECOVERY. Tappi 51 (10), 48A-51A (Oct. 1968).

Pulp mill air pollution problems are of three basic types: odor, particulate emissions, and sulfir dioxide emissions from power boilers. Black liquor oxidation is the single step most effective for odor reduction. Work has been completed on a pilot scale on the development of a weak black liquor oxidation system using southern kraft liquor with subsequent use of the liquor for SO2 scrubbing of power plant flue gases. The results of this work show that weak black liquor from southern kraft mills can be oxidized effectively by using kerosene for foam control. The scrubbing of the flue gas with the weak liquor by using a moderate head loss venturi scrubber (approximately 14 in. H2O) showed consistent SO2 removal efficiencies above 92%. Work by earlier investigators was confirmed, showing that approximately 80% sulfide oxidation gave the most effective SO2 absorption without any measurable release of hydrogen sulfide. Complete oxidation of sulfide enhanced the formation of sulfates which inhibited SO2 removal during scrubbing. The liquor can be recirculated for multiple passes through the scrubber provided the pH is kept sufficiently high to prevent lignin precipitation. The economics of the system indicate that a net savings of about 30 cents/ton air-dried pulp can be effected by installing the integrated oxidation and scrubbing system without any dollar credit for reduction in SO2 emissions.

11153

F. W. Hochmuth

ODOR CONTROL SYSTEM FOR CHEMICAL RECOVERY UNITS. Paper Trade J. 152 (40), 53-5 (Sept. 30, 1968).

The problem of odor pollution as it relates to chemical recovery units operating on waste black liquor from the kraft process is discussed. Background information, such as furnace operation, source of odor, and direct-contact evaporation is given. Emphasis is placed on a new system, the air contact evaporation system, which permits odor free operation of kraft recovery units. Data to support the new system, such as performance comparisons, cost comparisons, and test results are presented. 152(40):53-55, Sept. 30, 1968. CONTROL METHODS: By-product recovery, Air contact evaporation, Odor counteraction, Chemical processes The problem of odor pollution as it relates to chemical recovery units operating on waste black liquor from the kraft process is dis

11158

E. J. Malarkey and C. Rudosky

HIGH EFFICIENCY KRAFT MILL PRECIPITATORS. Paper Trade J. 152 (40), 57-8 (Sept. 30, 1968).

A dry collection system for recovery boilers in kraft mills is compared with a dry-wet system. Although high efficiency electrostatic precipitators can minimize fall-out or snowing, the dry-wet system can virtually guarantee that it will not occur. Comparative installation and operating costs are presented.

11673

Jones, K. H., J. F. Thomas, and D. L. Brink

CONTROL OF MALODORS FROM KRAFT RECOVERY OPERATIONS BY PYROLYSIS. Preprint, Public Health Service, Arlington, Va., National Air Pollution Control Administration, 20p., June 1968. 15 refs.

The pyrolysis and recombination steps of combustion in kraft mill processes were isolated for study because they encompass the reaction mechanisms responsible for producing malodorous compounds. Steady-state pyrolysis of concentrated black liquor was carried out over a temperature range of 480 to 1135 C to describe the process variables that would influence the design of a pyrolysis unit to minimize emissions of malodorous sulfur compounds from recovery operations. Several additional preliminary experiments were conducted using soda pulping liquor as a substrate with various inorganic sulfur salts added as the sole sulfur source for the purpose of describing production mechanisms for hydrogen sulfide as well as organic sulfur compounds. Results indicate the importance of temperature with respect to the relative production of malodorous sulfur compounds during the pyrolysis and recombination steps of kraft black liquor combustion. The requirement for definitive temperature control makes isolation of pyrolysis into a unit process attractive. The thermal efficiency of such a system coupled with the elimination of two unit processes currently in use further enhances such a design. The steady state data obtained in this study have provided the design parameters for a scale prototype system now under construction. The isolation and quantitation of organic sulfur compounds other than those most commonly reported suggest that they may be responsible for environmental perception when viewed in the relative framework represented by a simple odor model. The need for improved sampling and analysis of draft recovery process streams is indicated. (Author conclusions modified)

11726

Green, Bobby L.

BOILER FOR BARK-BURNING. Power Eng., 72(9):52-53, Sept. 1968

Burning bark involves special problems: incomplete combustion (and resultant gum-plugging in the system), dust and residue buildup, and multi-fuel firing caused by fluctuations in the supplies of bark. A paper mill has been burning bark in one of its boilers for 6 years. The boiler has a rated evaporation capacity of 300,000 lb/hr. and is provided with rotary regenerative air preheaters. The paper mill requires a continuous firing schedule of 75% to full capacity. When the bark supply is insufficient, natural gas is used. Equipment specifications include: horizontal-flow package regenerative air preheater (Ljungstrom), traveling grate stoker, large tube fly-ash collector, and hydraulic ash-disposal system. The boiler was designed to burn 35% and 65% natural gas, but operating logs show that the percentage of bark has been as high as 85%. A schematic drawing shows the arrangement of the preheating system. A cyclone dust collector, with large size tubes, is located in the flue gas path ahead of the air preheater. The cyclone removes bark char, fly ash, and other light material. The operating temperature is about 700 deg F. Features of the dust collection system are dust valves, a sand classifier, a cinder reinjection system, and a wet ash sluice system. Although no significant problems have been encountered in the 6 years of operation, initially some minor buildup did occur in the boiler superheater section when an unusually difficult combination of hardwood bark was burned. The problem was solved by the installation of retractable soot glowers. It has not been necessary to wash the preheater.

11949

Ginodman, G. M.

THE PURIFICATION OF GAS EMISSIONS IN THE SULFATE PULP MILLS. (Oschistka gazovykh vybrosov v sulfattselluloznom proizvodstve). Bumazhn. Prom. (Moscow), 22(7):16-22, 1947. 10 refs. Translated from Russian. 21p.

Methods are reported for cleaning the exhaust gases from pulp cooking in sulfate pulp mills; until recently, the extraordinary explosiveness and flammability of these gases has delayed progress in developing control processes. A detailed analysis of emitted gases was carried out. Vapors of turpentine and various methyl compounds are among the gases produced from the pulp cooking process and drawn off; the majority of the sulfur compounds are emitted into the atmosphere. Stack gases also have high dust content, consisting principally of sodium sulfate and carbonate salts, with most particles sized less than 60 micron. In the cooking plant, the greatest fire and explosion hazards are caused by turpentine blow-offs and increasing condensation of turpentine vapors. An explosion pipe was used to study the explosiveness of turpentine vapors and for gases liberated from mercaptan and hydrogen sulfide. Experiments showed that simple, save, and inexpensive combustion of disagreeably odorous gases can be performed in recovery furnaces under three conditions: stringent thermal control of the blowoff under cooling of the exhaust gases to a maximum of 30 C; subsequent dilution of the gases with air to at least fifty times their volume at the time of the final blowoff; and application of effective automated devices to prevent access to the furnaces of gas-air mixtures exceeding 30 C. The sulfur products of gas combustion are bound in the furnace with alkali. These conditions also ensure the maximum yield of commercial turpentine. A second method of gas cleaning judged effective in removing odorous sulfur organic compounds and H2S is treating the gases with alkaline solutions containing active chlorine. Suspension of milk of lime (80 g/l CaO) was used as the absorbing solution and calcium hypochlorite as chlorinating reagent, producing oxidation of sulfur and formation of higher acid anhydrides.

12076

PROGRESS IN ALKALINE PULPING-1967. THE INSTITUTE OF PAPER CHEMISTRY. Tappi, 51(12):77A-92A, Dec. 1968.

This report continues the series of yearly reviews, begun in 1947. of the technical and topical literature reporting progress in alkaline pulping. It reviews the literature abstracted in the Abstract Bulletin of The Institute of Paper Chemistry during the calendar year 1967 on mill modernization and expansion, technology, theoretical pulping studies, pulping of papermaking fibers, cooking liquors, by-products, stream and air pollution, bleaching, and corrosion. (Author's Abstract)

12506

Jones, K. H., J. F. Thomas, and D. L. Brink

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR, V. STEADY STATE PYROLYSIS. Preprint, 30p., 1968 (?). 12 refs.

The variables associated with the steady state pyrolysis of unoxidized kraft black liquor as well as soda liquor combined with various sulfur salts were determined. The temperature range spanned 480 to 1135 C. Measurements included mass balances of gross pyrolysis products, the qualitative and quantitative analysis of fixed gases, the qualitative and quantitative analysis of sulfur, and the heat content of the gas and solid phases. The results showed that pyrolysis has promise as a unit process for the control of emission levels of malodorous combustion products. The requirement for definitive temperature control in the pyrolysis step of combustion was clearly demonstrated. The thermal efficiency of the pyrolysis process with respect to potential heat recovery was quite acceptable. The fact that the wet gas effluent was self sustaining with respect to flame propagation eliminates the need for direct evaporation which in turn would eliminate the need for black liquor oxidation. Possible design schemes for the application of pyrolysis were presented previously. The steady state data provided design parameters which allow the construction of a scale prototype system. The isolation and quantitation of organic sulfur compounds other than those most commonly reported suggested that there is a definite need for improved sampling and analytical methods for the identification and quantitation of the total array of malodorous compounds being emitted to the environment of kraft mills.

12527

Morrison, J. L.

RECOVERY SCRUBBER FOR WASTE CHLORINE GAS. Tappi, 51(12):124A-125A, Dec. 1968. (Presented at the 5th Water and Air Conference of the Technical Association of the Pulp and Paper Industry, Portland, Oregon, April 1-4, 1968.)

Equipment was installed in a kraft mill bleach plant to combine and scrub waste gas discharges containing chlorine. Scrubbing was done with a 4% caustic solution. The scrubber, while improving atmospheric conditions, pays for itself by recoverying 96% of the waste chlorine as hypochlorite bleach liquor. (Author's abstract)

12658

J. L. Clement, J. S. Elliott

KRAFT RECOVERY BOILER DESIGN FOR ODOR CONTROL. Paper Trade J., 152(40):59-60, Sept. 30, 1968.

It is from the direct-contact evaporator, not the recovery furnace, that malodorous gases are emitted. Black liquor recovery furnaces can be operated with complete combustion of malodorous compounds. A recovery boiler design that will eliminate the direct-contact evaporator and is arranged to burn unoxidized black liquor supplied directly from the multiple effect evaporator to the furnace is presented. This design incorporated Scandinavian boiler design experience interpreted in terms of the North American kraft operations.

13072

Akamatsu, Isao and Hiroshi Kamishima

DEODORIZATION OF EXHAUST GAS IN KRAFT PULPING. 2. ON THE DEODORIZATION ACCORDING TO THE ADSORPTION AND ABSORPTION. (Kurafuto parupu seizo kotei haisui gasu no mushuka (dai niho). Kyuchaku oyobi kyushu ni yoru akushu seibun no jokyo ni kansuru kisoteki kenkyu). Text in Japanese. Kami-pa Gikyoshi (J. Japan Tech. Assoc. Pulp Paper Ind.), 23(6):25-30, June 1969. 16 refs.

Adsorption and absorption capacities for malodorous components were estimated at 20 and 29 C. The adsorption capacity of activated carbon for methyl mercaptan was larger than that for dimethyl sulfide. For the hydrogen sulfide, activated carbon acted not only as an adsorbent but also as a catalyst, so adsorption capacity of activated carbon for hydrogen sulfide was larger than that for the other sulfur compounds. When a mixture of dimethyl sulfide and methyl mercaptan was adsorbed on activated carbon, the total adsorption capacity of activated carbon was a medium capacity between those for individual components. Because real kraft pulp blow gas is a mixture of methyl mercaptan, dimethyl sulfide and others, the adsorption of activated carbon for one was the mixture adsorption, and the adsorption capacity was 30 to 40%. The absorption capacity of polyvinyl chloride for dimethyl sulfide was moderately large, but dimethyl sulfide in air was absorbed only partially. The absorption reaction of ferric oxide for hydrogen sulfide resulted in water as a reaction product, therefore exact measurement of absorption was difficult. (Author abstract modified)

13331

Lee, G., N. J. Themelis, and W. H. Gauvin

CHEMICAL RECOVERY FROM SODIUM-BASE SPENT SULPHITE LIQUORS BY THE ATOMIZED SUSPENSION TECHNIQUE. Tappi, 41(6):312-317, June 1958. 18 refs. (Presented at the Summer Meeting, Tech. Sect. of the Canadian Pulp and Paper Assoc., Saranac Lake, N. Y., June 1957).

The treatment of preconcentrated acid sodium sulfite spent liquors was studied in the Pulp and Paper Research Institute of Canada's 8 in. atomized suspension reactor. Wall temperatures of 650-800 C and residence times of 14 to 22 sec were used to investigate the effects of the liquors on the nature and composition of the resulting products. Sodium salt was recovered in the very form required for sulfiting, namely as sodium carbonate. Unlike other proposed procedures, the atomized suspension technique produced few traces of sodium sulfide and thiosulfate and only small amounts of sodium sulfate. The combustible gas produced during pyrolysis possessed good calorific value, and was available in sufficient quantity to make the process thermally self-sufficient. As much as 80% of the sulfur originally present in the spent liquor was recovered in the gas. In addition to its excellent chemical recovery, the process operates as a completely closed system, eliminating the pollution potential of the treated liquor and permitting total recycling of the process water. Translation of these results to a recovery plant for a sodium-base pulp mill is outlined and a crude, preliminary economic evaluation is given. Optimum operating conditions must be determined and additional engineering obtained before a commercial installation is attempted. (Author conclusions modified)

13334

Ruus, Av Lennart

INVESTIGATION OF ODOR ELIMINATION BY AB MORRUMS BRUK, MORRUM. (Undersokning av luktelimineringsanlaggning vid AB Morrums Bruk, Morrum). Text in Swedish. Svensk Papperstid. (Stockholm), 66(15):554-557, Aug. 15, 1963. 1 ref.

An oxidation tower system for reducing odorous compounds formed during alkaline pulping was developed by the British Columbia Research Council and installed at AB Morrums Bruk, Morrum, Sweden, where its efficiency was investigated.

The system involves the pumping of black liquor through the oxidation tower in the same direction as a gas mixture containing air, uncondensed gases from the turpentine recovery, and gases from the digester blow. After leaving the oxidation tower, the mixture is washed with chlorine and dilute sodium hydroxide in a scrubber before being vented into the atmosphere. Gas chromatographic determination of the amount of methyl mercaptan, dimethyl monosulfide, and dimethyl disulfide in the gas mixture before and after it had passed through the tower and scrubber reveals that the system removes more than 99% of the methylsulfides and more than 97% of the mercaptans. The greater part of these compounds is taken up by the black liquor in the oxidation tower; the rest is oxidized in the scrubber. The concentration of the odorous compounds in the outlet from the scrubber is very low and their smell can be characterized as 'faint'. About 90% of the sodium sulfide in the black liquor is oxidized in the oxidation tower. (Author abstract modified)

13398

Fones, R. E. and J. E. Sapp

OXIDATION OF KRAFT BLACK LIQUOR WITH PURE OXYGEN. TAPPI, 43(4): 369-373, April 1960. 6 refs.

Oxidizing black liquor from a kraft cooking process reduces kraft- mill odor, reduces corrosion in the evaporators, and minimizes the loss of sulfur compounds in the recovery process. Oxidation of kraft black liquor in a pressure vessel with pure oxygen as a possible means of circumventing some of the foaming problems attending the oxidation of black liquor is investigated. Experimental investigations tested the feasibility of oxidizing black liquor with pure oxygen either after separation from the pulp or just prior to blowing at the end of a normal kraft cook. All cooks were carried out in a laboratory experimental digester. Oxidation of the pulp alone resulted in the pulp darkening and the lignin content increasing. Oxidation of the black liquor alone would require the reducing the sodium sulfide content to prevent the formation of sodium thiosulfate. Costs of reducing the sodium sulfide content and the cost of the oxygen ($1100 per day) were too expensive for current applications. Although oxidation of pulp and black liquor at the end of a normal kraft cook results in complete oxidation, oxygen consumption rates are high and pulp strength and color are adversely affected.

13409

Wenzl, Herman F. J. and O. V. Ingruber

BLACK LIQUOR BURNING AND CHEMICAL MADE-UP. Paper Trade J., 150(50):54-57, December 12, 1966. 29 refs.

A new proposal for maintaining sulfidity in the kraft process assumes that multistage bleaching of kraft pulp uses mainly chlorine and chlorine dioxide obtained from the reaction of sodium chlorate with sulfuric acid. In addition to chlorine and chlorine dioxide, large amounts of sodium sulfate are formed. The proposal also suggests the use of white liquor instead of sodium hydroxide in the alkaline extraction stages of bleaching. The heart of the recovery system is the steam boiler. Apart from the recovery of inorganic components from the combustion of waste liquor in the form of a smelt, the organic substances in the black liquor are burned in the same process and their heat is used for steam generation covering the heat and energy requirements of the whole mill. Presently, recovery boilers for 1000 tons of pulp per day are in operation. One unit is designed for a throughput of 1340 tons of dry substance per day at a dry content of 65-68% of the injected liquor. Steam production is 225 tons/hr at 600 psig pressure and 380 C exit temperature. To remove the smelt uniformly the number of smelt spouts has been increased. Explosions which occur when smelt enters dissolving tanks are probably related to the formation of elemental sulfur. About 95% of the suspended particles from hot furnace gases can be recovered with scrubbers consisting of cylindrical upright tanks. Gas is blown tangentially at high velocity into the tank bottom while water is sprayed from a tube with large numbers of spray nozzles. Water is recycled from the bottom to the spray tube.

13438

Mannbro, Nils

THE SULFIDE RECYCLE RECOVERY PROCESS PART I. SMELT COMPONENT SEPARATION AND RECYCLE RATIO. Svensk Papperstid., 65(23): 956-964, Dec. 15, 1962. 20 refs.

Most commercial processes for the recovery of chemicals from sodium-base sulfite spent liquors comprises two-stage combustion with the sulfide component of the smelt produced in the first combustion stage burned to form sulfur dioxide in the second stage. This sulfur dioxide and that of the flue gas are ultimately reacted with the sodium carbonate component of the smelt to form a sodium sulfite/bisulfite solution. By not processing smelt for hydrogen sulfide, the Sulfide Recycle Process permits the direct recycling of the sulfide component to the recovery furnace. Smelt is converted by separating sodium carbonate crystals from a concentrated sodium sulfide solution. The sodium sulfite is recycled to the furnace and converted there to sulfur dioxide and sodium carbonate. The sulfur dioxide is recovered from the flue gas by absorption in a liquor prepared from the separated sodium carbonate crystals. Crystallization of the soda involves the ternary system Na_2S-Na_2CO_3-Na_2SO_4, and a formula was developed for calculating the increased smelt flow from the furnace and equilibrium smelt sulfidity. Calculation examples emphasize the importance of preventing oxidation of the sodium sulfide prior to its combustion in the recovery furnace. Successful operation of the Sulfide Recovery Process depends on complete conversion of the sodium sulfide to sodium carbonate and the lowest possible reformation of sodium sulfide in the discharged smelt. The process employs equipment and procedure standard in the pulp industry.

13445

Deeley, J. E. and A. H. Kirkby

THE DEVELOPMENT OF THE CHEMICAL RECOVERY BOILER. J. Inst. Fuel, p. 3-10, Sept. 1967. (Presented to the Scottish Section of The Institute of Fuel, March 22, 1966.)

The main constituent of the digesting liquor in the acid or sulfite process of pulp production is either calcium bisulfite or magnesium bisulfite; both produce a residual liquor which makes recovery difficult. The residual liquors from the alkali or sulfate process of pulp production can be treated simply, which solves the disposal problem and achieves chemical recovery. To recover the black liquor, it is sprayed across a furnace to the side and rear walls through a nozzle. The deposit is in the form of char which accumulates to an appreciable thickness while it is being concentrated by heat from the combustion gases. When dehydration is complete, the dry char falls to the furnace hearth. The smelt formed flows through a tapping hole, where it is discharged into a dissolving tank. To combat low-temperature corrosion, the high- temperature electric precipitator and a circulating economizer with indirect air heating have been especially developed for the recovery unit. The difficulties and operating hazards of a recover furnace are related to combustion, smelt removal, furnace explosions, and smelt leakage.

13447

Hoag, D. S.

ANALOG COMPUTER CONTROL OF A KAMYR DIGESTER. Tappi, 47(12):734-741, December 1964. 1 ref.

The principles of applying an analog computer to control an industrial process are discussed and illustrated with a specific example. The Honeywell KDC 2020 analog computer has been developed to control a Kamyr digester during changes in wood species, production rate, permanganate (K) number, and alkali-to-wood ratio. It can also be used to correct for K number drift during steady state operation. Verification of a semitheoretical math model of the Kamyr cooking process and determination of its coefficients was made by extensive planned testing on an operating digester. The computer has been calibrated and tested for both southern pine and mixed hardwoods with considerable success. Some mill operating experience has been obtained cooking pine chips.

13464

Wenzl, Hermann F. J.

CAUSTICIZING AND CLARIFYING KRAFT PULPING LIQUORS. Paper Trade J., 151(2):50-53, Jan. 9, 1967. 12 refs.

Causticizing of green and white liquors can be expressed as CaO H20 Na2C03 yields 2NaOH CaCO3. The reaction is reversible, and even under favorable conditions, no more than 85-90% conversion is achieved. The incomplete reaction is due either to the increasing solubility of calcium carbonate with increasing amounts of hydroxyl ions in solution or to the fact that it occurs on the surface of suspended lime particles which lose their reactivity as they become covered with a layer of CaC03. The clarification of green liquor is improved by the addition of lime, but increased amounts of mud must be washed. Attempts to dry lime mud with hot gases have led to the development of the flash drying process, in which a portion of collected lime of 90-99% dry content is mixed with wet mud coming from washers to increase the dry content of the lime. In one installation the equipment has increased kiln efficiency 100%. However, the operation of a fluidized bed calciner may be simpler than that of a kiln and less sensitive to changes in throughput. A modified Pease-Anthony venturi scrubber has an efficiency between 94.0 and 98.5%.

13551

Faith, W. L.

AIR POLLUTION ABATEMENT. SURVEY OF CURRENT PRACTICES AND COSTS. Chem Eng. Progr., 55(3):38-43, March 1959. 8 refs.

Pollutants and control methods of the chemical manufacturing, pulping, petroleum refining, steel, food, and cement manufacturing industries are reviewed. Chief pollutants from the chemical industry are dilute vent gases, acid mists, waste sulfides, nitrogen oxides, combustible wastes, and dust. Vent gases are best controlled by catalytic oxidation, sulfides by caustic scrubbers, nitrogen oxides by catalytic reduction, combustible wastes by incineration, and dust by filtration. No standard procedure has been adopted for abatement of acid mists. Pulp and paper industry pollutants are fly ash, dust and odors. Electrostatic precipitators, dust scrubbers, and spray towers are used to combat these problems. Air pollution by the petroleum refining industry is caused by sulfur compounds and hydrocarbon loss. Sulfur compounds can be reduced by absorption and hydrocarbons by several control methods. The main pollutant from the steel industry is dust, which can be controlled by electrostatic precipitators and wet scrubbers. The main problem of the food industry is control of odor, which is combatted by activated carbon adsorbers. Dust from cement industries is best controlled by glass fabric bag filters or cyclone collectors. Costs for 1959 are given for the various control methods.

13737

Ibrahim, Karen

POLLUTION: THE PRESSURE IS ON. Graphic Arts Progr., 15(4):6-15, April 1968. 31 refs.

Air pollution is an important issue in both the printing and pulp-and-paper segments of the graphic arts industry. The main pollutant of the printing industry is the gaseous emission of solvents (aromatic hydrocarbons) from the dryers. Attempts are being made to control the pollution by thermal or catalytic combustion or by the use of adsorption devices. Thermal combustion involves the direct burning of the effluent in a gas-fired incinerator which is effective in eliminating pollution but at present is economically unfeasible. Catalytic combustion differs from thermal combustion in that it is flameless. Adsorption devices utilize activated carbon as the adsorbent; and this method is also economically unfeasible. Another method for solvent-pollution control is the development of mild or low- aromatic nonoffending solvents. Pulp and paper-makers are primarily concerned about the emission of gases which contain sulfur, mainly SO2 and H2S. Among control methods are (1) proper operation of recovery furnaces and (2) installation of black liquor oxidation units or forced-circulation evaporators. The difficulties in proper monitoring and sampling, in setting standards, and in paying for control equipment and its operation, in both areas of the graphic arts industry are stressed.

13772

Guest, E. T.

DEVELOPMENTS IN BLACK LIQUOR OXIDATION. Pulp Paper Mag. Can., 66(12):T 617-T 622, Dec. 1965. 8 refs. (Presented at the Annual Meeting of the Pacific Coast Branch, Tech. Sect., Canadian Pulp and Paper Assoc., Harrison Hot Springs, B. C., May 9-11, 1963.)

The overall status of black liquor oxidation in the West Coast kraft pulp industry is reviewed. The most prevalent oxidation techniques are the Collins system, the B. C. Research Council system, and the Troebeck-Ahlen system. The Troebeck-Ahlen and the Collins type systems oxidize by forcing air through the liquor to make a controlled volume of foam. The B. C. Research Council unit operates with air blowing concurrently with the liquor over specially designed plates. Other systems use packed columns with either concurrent or countercurrent air, compressed air in a tank of liquor, or compressed air in a pipeline. The Crofton pilot plant has incorporated a more positive pattern of liquor flow to combat difficulties in maintaining pressure drops, an integral foam box with carryover space, a new type of combination cyclone with a foam breaker, and a simplified square design into its system. The several advantages to black liquor oxidation include a reduction of odor in the evaporator condensate and recovery stacks, reduction in sulfur losses, and less corrosion of the mild steel evaporator tubes and strong black liquor piping. Reduction in the recovery furnace odor emission can only be obtained when a furnace is not overloaded and therefore operated with sufficient air.

14094

Shah, I. S.

NEW FLUE-GAS SCRUBBING SYSTEM REDUCES AIR POLLUTION. Chem. Eng., 1967:84-86, March 27, 1967.

Chemico's new two-stage scrubbing system enables pulp mills to greatly improve overall dust collection efficiency and to meet stricter air pollution regulations. Flue gases from the recovery boiler enter the two-stage system, which consists of evaporator, scrubber, separator, and cooling tower, and are vented to the stack 99% cleaner and 500-600 F cooler. Concentrated black liquor is further concentrated to 60-70% solids content by direct contact with flue gases in the Venturi evaporator. With about 40 in. H2O static pressure for the system, the outlet dust leading can be reduced to 1 lb/ton of pulp. The two-stage system provides greater heat recovery because it exhausts stack gases at temperatures below 120 F, as compared to 325 F from electrostatic precipitators, and 180-190 F from single-stage scrubbing systems. Chemico has also perfected two oxidation systems for black liquor that reduce the amount of H2S emitted to atmosphere. One is for weak black liquor and the other for strong black liquor.

14110

Galeano, Sergio F.

REMOVAL AND RECOVERY OF SULFUR DIOXIDE IN THE PULP MILL INDUSTRY. Florida Univ., Thesis (Ph. D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1966, 239p. 149 refs.

Technical and economic feasibilities of a purification system for the removal of sulfur dioxide in pulp mills were studied. Applications in both kraft and neutral semichemical systems are offered. An experimental pilot plant with a capacity of 2800 cfm consisting of a venturi scrubber and a cyclone was used in the various experiments. The pilot plant was designed for use as a purification system for either the kraft or the semichemical systems. Two different scrubbing solutions were used. A carbonate solution proved technically feasible in the semichemical process. Sulfur dioxide removals in excess of 90% were obtained. Weak black liquor, obtained before it reached the evaporators, was used in the kraft process. Sulfur dioxide removal was again in excess of 90%. A venturi-cyclone combination and a spray chamber with radial inlet and lateral sprayers were studied using both the carbonate solution and weak black liquor as scrubbing solutions. The proposed system was found to be both technically and economically feasible for the carbonate scrubbing solution in the semichemical process. The use of weak black liquor as a scrubbing solution in the kraft process proved to be technically feasible. Its economy is a matter of more flexibility dictated by the particular conditions of each plant. (Author abstract modified)

14113

Murray, F. E.

AIR POLLUTION FROM BIVALENT SULFUR COMPOUNDS IN THE PULP INDUSTRY. Preprint, Engineering Institute of Canada, March 1968, 16p., 10 refs. (Presented at the Banff Pollution Conference, Banff, Alberta, Can.)

In the kraft process of producing chemical cellulose from wood chips, the chips are cooked in a solution containing sodium hydroxide and sodium sulfide in about a four-to-one proportion. This method produces much greater air pollution, in the form of highly malodorous compounds, than the alternative sulfite processes. The three primary sources of odor production in a kraft pulp mill are the digestion process, the direct-contact evaporator, and the recovery furnace. In the digestion process, control must be effected on the noncondensible gases from the digester and blow tank, from the multiple-effect evaporators, and on the foul condensates that are formed in contact with these gases. The emission of hydrogen sulfide from black liquor during direct contact evaporation can be very substantially reduced by oxidation of the sulfide. The problem of the recovery furnace is one of good operation and combustion control within the furnace design capacity. Present laboratory studies are expected to lead to continuing improvement in the control of odorous emissions from kraft pulping operations.

14118

Markant, H. P.

THE MEAD RECOVERY PROCESS. TAPPI, 43(8):699-702, Aug. 1960. 2 refs. (Presented at the 45th Annual Meeting of the Technical Assoc. of the Pulp and Paper Industry, New York, Feb. 22-25, 1960.)

The Mead neutral sulfite recovery process consists of two basic stages: the total carbonation stage and the sulfiting stage. Green liquor from a storage tank is fed to a precarbonation tower, where it comes in contact with 15% of the total gas in the carbonation tower. When the gas enters the precarbonation tower, it contains H2S that was released in the carbonation tower. This is reabsorbed by the green liquor, and H2S-free gas is discharged to the atmosphere. The precarbonated liquor is passed to the carbonation tower, where it absorbs CO2 and releases H2S. The gas loses CO2 and gains H2S. The next phase of the process takes place in a sulfiting tower. Here the SO2 in the flue gas from a venturi scrubber cyclone separator is scrubbed with the carbonated liquor. The addition of more contact surface in the absorption system has reduced odors from the process and brought them within acceptable limits. Improvements in the venturi scrubber and the installation of a droplet agglomerator in the sulfiting tower have reduced the amount of particulate matter leaving the process to an extremely low level. The total stack gases are continuously monitored for SO2 and H2S, and concentrations are not permitted to exceed 0.03 and 0.01%, respectively.

14120

Boyer, Robert Q.

THE WESTERN PRECIPITATION RECOVERY SYSTEM. TAPPI, 43(8):688-698, Aug. 1960. 21 refs.

The Western Precipitation recovery system, which uses the crystallization separation of the sodium sulfide of the smelt, reacts all of the separated sodium sulfide with the spent liquor sulfite sulfur through an oxidation reduction reaction known as the Bradley process. The reacted liquor is evaporated and burned in inexpensive kraft equipment. The cooking liquor is produced by adsorption recovery of the flue-gas sulfur dioxide in a sulfite-bisulfite solution that uses the recovered sodium carbonate as the make-up base. The absorption of the SO2 take place in a recovery tower where sodium carbonate is injected in a 1:1 ratio to the sulfur. The sulfur dioxide recovery tower is capable of a 97% efficiency. Any traces of H2S are removed from the solution in a separate head tank, thus eliminating odor. This system at an experimental recovery plant has completely processed spent liquor from sodium-base acid sulfite, two-stage sulfite, and NSSC cooks separately and in combinations. The scale formation in the evaporators is eliminated with the proper pH control by the amount of recycled sulfide sulfur. This sulfur can be either increased with the addition of sodium sulfate to the firing liquor or reduced with addition of inventory sodium sulfide. A relationship between the rise in pressure and rise in boiling point is used to control the evaporation-crystallization. High sulfur, soda, and heat recoveries are possible. (Author abstract modified)

14577

Wethern, James D.

METHOD OF PROCESSING SULFATE BLACK LIQUOR TO YIELD METHYL MERCAPTAN AND DIMETHYL SULFIDE. (Riegel Paper Corp.) U. S. Pat. 3,333,009. 2p., July 25, 1967. (Appl. March 22, 1965, 8 claims.)

In addition to improved overall by-product yield, the process of the invention is capable of giving an improved yield of relatively more valuable methyl mercaptan in proportion to dimethyl sufide. At the same time, it affords a desirable measure of control over the relative proportions of the principal by-products. Spent kraft black liquor is initially dried and then homogeneously mixed with elemental or combined sulfur. The mixture is heated in a closed reaction chamber in contact with a flowing stream of heated carrier gases to effect pyrolytic decomposition of the liquor solids. Evolved by-products are continuously removed by the carrier gas, usually nitrogen or superheated steam. Recovery of the sulfur by-products is effected by separation from the carrier gas.

14940

Tada, Mitsuru

INDUSTRIAL WASTE INCINERATION BY FLUIDIZING SYSTEM. (Sangyo haikibutsu no ryudoshokyakuho). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(7):529-533, July 1969.

Fluidizing systems, which are widely applied to petroleum and mineral combustion, are highly efficient. The outstanding merits of this system are a capacity of 500 kg/cu m-hr incineration; the ability to incinerate low-calorie wastes (1000/k-cal/kg, water 70%) without catalysts; perfect combustion with kiln heat around 750 C; no stack smoke or odor problems; simplicity of structure, with no vibrations inside the kiln and constant and stable internal heat; availability of electric power, produced though the process in large-scale (400 t/day) kilns of this system; convenient operation requiring no heavy or intensive labor; and economical maintenance. The system has a wide range of applications, including waste incineration in the chemical, food processing, and petroleum industries, and excrement and sludge treatment. For example, the liquid wastes from paper manufacturing plants that used to be discharged into rivers, bays, or seas and caused problems for agriculture, fishing, and shipping may now be incinerated, removing all the organic matter contained in pulp wastes, and chemical compounds such as $Na2SO4$ or $Na2CO3$ may be recovered and reused in kraft pulp production. Adaptation of this system to watery wastes in the food and chemical industries has the advantages of deodorizing wastes and recovering ash for use as fertilizer. The system can be adapted to petroleum and petrochemical wastes and to high-temperature wastes.

15450

Schoenhofen, Leo H.

TURNING INTO PROFITS SOME AREAS OF POLLUTION CONTROL. Flexography, 13(10):24, 26-27, 57, Oct. 1968.

The control of water pollution as it relates to the manufacture of paper and paperboard is discussed, particularly as it relates to making it into a profit opportunity. A Wabash mill reduced its water intake by half through a reappraisal and tightening of the system. A capital cost of $338,500 reduced the solids content of the water from 10 lbs per thousand gallons to 0.5 lb per thousand gallons. However, reclaimed fiber from this filtering system resulted in $34,000 yearly profit above the annual operating costs of the system. An Indiana mill installed a Container- Copeland process for the elimination of black liquor generated by some pulping processes at the cost of a million dollars. The sale of a salt-cake by-product from this new process reduced the net operating costs. The waste materials which industry is discarding into the air, water, or ground are potential raw materials for one or more industries analogous to the cylinder paper mill business. Several of the 92 major pollution control projects initiated by Container Corportation of America since 1960 have either shown actual profit or a potential for profit; many have increased the total profit picture of a given facility by curbing the outlay for temporary control. These 92 projects do not include systems which have been installed to increase plant efficiency as well as to serve as antipollution devices, such as boilers which reclaim chemicals which are otherwise lost as waste. But recovery boilers and similar systems should be looked upon as early steps in the direction of turning a problem into a profit.

15690

Oloman, C., F. E. Murray, and J. B. Risk

THE SELECTIVE ABSORPTION OF HYDROGEN SULFIDE FROM STACK GAS. Pulp Paper Mag. Can. (Quebec), 1969:69-74, Dec. 5, 1969. 7 refs. (Presented at 55th Annual Meeting of the Technical Section, Canadian Pulp and Paper Association, Montreal, Jan. 28-31, 1969.)

Selective absorption of hydrogen sulfide in a wet scrubber is proposed as a method of reducing the odor from kraft pulp mill recovery stack gases. A solution of sodium carbonate and bicarbonate, which is 2M in sodium, is in equilibrium with the carbon-dioxide content of the recovery stack gas and has a pH of about 9.5. The solution will selectively absorb hydrogen sulfide from the stack gas provided its sulfide content is kept low. Hydrogen sulfide absorption efficiencies of over 90% were obtained in a pilot absorption unit consisting of a packed column working in series with air sparged liquor oxidizers. The process rates indicated that an efficient absorption system for a 500 t.p.d. kraft pulp mill would require a 20-ft-diameter absorption column, with 10 ft of packing, using 3000 g.p.m. of recyling carbonate liquor. The value of the recovered chemicals was not expected to pay for the cost of recovery-gas scrubbing. (Author abstract modified)

15709

Hough, Gerald W. and Lyle J. Gross

AIR EMISSION CONTROL IN A MODERN PULP AND PAPER MILL. Am. Paper Ind., 51(2):36-37, 40-42, 44. Feb. 1969. 18 refs.

Increasing concern about the environment in the U. S. is causing federal, state, and local governments to legislate increasingly stringent laws governing emissions from industrial plants. The concepts which a pulp and paper mill can adopt to reduce emissions to levels which have been proven to be attainable are discussed. The amount of water vapor, particulate matter, and sulfur emissions in pounds per ton of pulp from each operation of the kraft pulp mill is compared before and after application of suitable controls. Air emission control systems increase both the capital and operating costs of pulp mills. Order of magnitude capital cost estimates for the air emission control equipment for a new 500 tpd pulp mill are presented.

15766

Markant, Henry P., Norman D. Phillips, and Indravadan S. Shah

SYSTEM FOR ABSORBING H2S GASES. (Babcock & Wilcox Co., New York) U. S. Pat. 3,471,249. 4p., Oct. 7, 1969. 7 refs. (Appl. Feb. 2, 1965, 6 claims).

In the sulfate, or Kraft, process for producing paper pulp, hydrogen sulfide is released by the hot combustion gases used to concentrate partially concentrated liquor prior to its incineration. Its removal is desirable to minimize air pollution, but known absorption systems have been applicable only to high concentrations and have required the use of commercially prepared absorbing solutions. In the present invention, it is shown that less than 1% hydrogen sulfide and carbon dioxide can be absorbed by the green liquor produced by sulfate recovery processes. These liquors contain as active compounds sodium sulfide, sodium hydroxide, and sodium carbonate. In the absorption process, precooled gases are passed through an absorption zone of a venturi-like device, in which the absorbing liquid is injected at a gas flow ratio of 6 to 10. Absorption of hydrogen sulfide by the liquid, which is recirculated, forms sodium hydrosulfide as one stable compound. The ratio of the weight of sodium sulfite in the solution must be greater than 35; the weight ratio of hydrogen sulfide in the gas, greater than 30; and the molar concentration of sodium sulfide, greater than 0.1 times the molar concentration of sodium hydrosulfide.

15779

Collins, Theron T., Jr.

ODOR CONTROL AND HEAT RECOVERY IN WOOD PULPING PROCESS. (Assignee not given.) U. S. Pat. 3,183,145. 9p., May 11, 1965. 6 refs. (Appl. June 22, 1962, 10 claims).

Methods are described for controlling the pollution of the atmosphere and bodies of water in the vicinity of wood pulping mills. The method is described in terms of the wood pulping process; however, it may readily be adapted for use with other wood pulping processes that emit waste condensates which contain such odorous and noxious gases as methyl mercaptan and hydrogen sulfide, as well as hot water vapor laden gases which contain sulfur dioxide. The gases are passed into contact with black liquor prior to the concentration, thus oxidizing the liquor. For example, sulfur dioxide containing gases derived from the lime kiln and/or the recovery furnace are contacted with one or more of the condensates containing the sulfur compounds as hydrogen sulfide and methyl mercaptan, under conditions which cause condensation of at least a portio of the water vapor in the hot gases. A portion of the sulfur dioxide content of the hot gases reacts with a portion of the hydrogen sulfide and/or methyl mercaptan content of the condensates to render the undersirable odor producing compounds innocuous. Simultaneously, the alkaline components of the condensates are carbonated and the condensates are stripped of substantial portions of the unreacted sulfur compounds. The effluent gases are then oxidized, preferably using active chlorine containing bleach plant wastes, to oxidize the remaining odor producing materials in the gases. The condensates are cooled so as to recover a portion of their heat content and to simultaneously render the residual unstripped gases more soluble.

15878

Bacon, Raymond F. and Rocco Fanelli

RECOVERY OF SULPHUR DIOXIDE FROM GASES. (Assignee not given.) U. S. Pat. 2,142,987. 3p., Jan. 10, 1939. (Appl. Dec. 24, 1935, 3 claims).

Sulfur dioxide can be recovered from mixtures, either in gaseous or liquid form, by treating gases with an aqueous solution of a free weak acid and a salt of a water-soluble weak acid. Suitable acid salts include acetic, benqoic, fumaric, lactic, phosphoric, citric, and tartaric. The free weak acid can be the same as that forming the salt. The salts react with sulfurous acid to regenerate the weak acid and produce a sulfite which decomposes under the influence of heat with the liberation of sulfur dioxide. They are stable and nonvolatile at the temperature used for the liberation of sulfur dioxide. The amount of weak acid employed should be equivalent to 68 grams of lactic acid per liter. Such an amount materially increases the rate of liberation of sulfur dioxide from the absorption solution at its boiling temperature as compared with the rate of liberation of sulfur dioxide at the boiling temperature from a similar absorption solution containing no free weak acid. The process is an economical way of producing sulfur dioxide-bearing reagents for various chemical and metallurgical uses as, for example, in the production of sulfuric acid, in the production of elemental sulfur, in the refrigeration and leaching of ores, and in the production of sulfite cooking liquors.

15992

Springer, Karl L.

PROCESS AND APPARATUS FOR THE RECOVERY OF SULPHUR DIOXIDE FROM SULPHITE LIQUORS. (Standard Oil Development Co., Elizabeth, N.J. U. S. Pat. 2,137,311. 3p., Nov. 22, 1938. (Appl. March 26, 1936, 3 claims).

A method is described for recovering sulfur dioxide in an anhydrous condition from petroleum sulfite liquor. Concentrated sulfuric acid is fed into the top of a packed tower and then to a reaction chamber along with the sulfite liquor. The reaction of the sulfuric acid and the sulfite liquor causes sulfur dioxide to evolve. The sulfur dioxide passes into a liquid reaction mixture in a separate stripping zone. A current of steam is passed through the reaction mixture to strip it free of sulfur dioxide. The mixture of sulfur dioxide and steam is passed through a cooling zone at a temperature suitable for the condensation of the steam. By passing the resulting sulfur dioxide through a packed tower in countercurrent to the initial sulfuric acid, the sulfur dioxide is rendered anhydrous. The method is also applicable to the sulfite cellulose liquor of the paper industry.

16041

Rosenblad, C.

RECOVERY OF HEAT AND SO2 GAS IN THE SULPHITE PULP INDUSTRY WITH OR WITHOUT HEAT EXCHANGERS. Paper Trade J., 106(26):78-81, June 1938. (Presented at the Annual Meeting of the Pulp and Paper Mill Superintendents Association, Toronto, June 22-24, 2938.)

Direct and indirect methods of heating the acid used in heat and sulfur dioxide recovery processes are contrasted. In the indirect system, relief gases from the digester are injected directly into the acid without intermediate cooling. The temperature and the concentration of the acid are difficult to regulate, since heating and strengthening take place simultaneously. In the indirect system, the acid is concentrated to full strength in cool condition by cooled gases from the digester relief and subsequently heated indirectly by the heat liberated when the digester is relieved and blown. No pressure tank is required during the concentration, and the relief of the digesters can be accomplished without any interference from back pressure. It is possible to obtain a final acid temperature higher than 156 F without using heat sources other than the relief steam and blow vapors. If a higher acid temperature is desired, digester temperature must be increased or additional heat added indirectly by a central acid heating system. In one condensing plant, part of the concentrated acid is heated in a relief cooler and the balance, in a spiral heat exchanger. The SO2 gases cooled in the condensing plant and relief cooler are taken to raw acid tanks and used for strengthening the acid. Though pressure tanks are used for the concentrated acid, they could be replaced by spiral heat exchangers.

161970

Ioffe, L. O.

CALCULATION OF THE FINAL GAS BLOW-OFF IN THE SULFITE COOKING OF CELLULOSE. (Raschet konechnoy gazovy sduvki pri sul'fitnoy varke tsellyulozy). Text in Russian. Bumazhn. Prom. (Moscow), no. 6: 18-20, 1966. 6 refs.

A procedure was determined for calculating the final gas blow-off in sulfite cooking of cellulose. It was shown that on decreasing the temperature of the boiler contents by 20 deg, the concentration of free sulfur dioxide in the liquor is decreased to hundredths of a percent (independent of the initial temperature and initial concentration of sulfur dioxide before the blow-off). Thus, at a 2% content of sulfur dioxide and an initial temperature of 140 deg, when the temperature is lowered to 130 deg and then to 120 deg, the sulfur dioxide content decreases to 0.181 and then to 0.009%; at an initial temperature of 130 deg decreased to 120 deg and then to 110 deg, the amount of sulfur dioxide decreases to 0.115 and 0.003% respectively.

16242

Blomen, T.

THE ROSENBLAD SYSTEM FOR RECOVERY OF HEAT AND SULPHUR DIOXIDE IN THE CHEMICAL WOOD PULP INDUSTRY. Tech. Assoc. Pap., Ser. 20, no. 1:346-348, June 1937. (Presented at the Annual Meeting of the Technical Association of Pulp and Paper Industry, New York, N. Y., Feb. 22-25, 1937.)

A new storage system for recovering waste heat from wood pulping operations is economical to operate at peak loads and enables exhaust vapors from digestors and waste vapors from other mill departments to be utilized. Blow steam is pumped to an accumulator to start the circulation of water from the bottom of the tank through a jet condensor to the cyclone top of the tank. In the jet condensor, steam is condensed by the cold water, raising the temperature of the water to 203 F. The steam condensate is passed to the top of the tank, together with the cooling water. In the tank, the heat exchanger and its pump are so proportionated that there is a distinct demarkation between hot and cold water. Hot water from the top of the tank is pumped off and cooled to 104 F. The cooled water is then returned to the suction side of the cold water pump or to the bottom of the tank. Water to be heated is brought from outside the heat exchange to a hot water tank rather than heated directly in the jet condensor because vapors coming from digestors are general mixed with black liquor and odorous gases. These impurities are caught by the cooling water in the jet condensor and filtered off. Sulfur dioxide is similarly recovered by adding a gas cooler to the top of the accumulator. The system is appropriate for both sulfate and sulfite mills.

16350

Maksimov, V. F., O. I. Sokolova, Z. P. Modzelevskaya, and N. M. Isayeva

PURIFICATION OF THE WASTE GASES OF SULFATE-CELLULOSE PRODUCTION ON FOAM TYPE UNITS. Bumazhn. Prom. (Moscow), 34(5):14-16, May 1959. 2 refs. Translated from Russian. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 8p.

Experiments were conducted on the decontamination of exhaust gases in sulfate-cellulose production by the foam method, based on the interaction of a gas and liquid in a layer of moveable foam formed as a result of their counterflow. It involves the purification of gases from the plant furnace, concentrator, and boiler units. When the gas flow rate of the foam device was varied from 0.4 to 3.2 m/sec, the purification of furnace gases was constant and amounted 92-95% (based on total sulfur). After purification, 10-40 mg/cu Nm hydrogen sulfide, 8-46 mg/cu Nm methyl mercaptans, and 3-120 mg/cu Nm sulfur dioxide were present in furnace flue gases. Decontamination of the boiler gases removed 92% of the hydrogen sulfide, 90.7% of the methyl mercaptans, and 86.0% of the sulfur dioxide. When the simultaneous decontamination of exhaust gases from furnace, concentrator, and boiler sections was studied, using caustic soda as a wetting liquid, 92.3% of the hydrogen sulfide, 84.7% of the methyl mercaptans, 86.6% of the dimethyl disulfide, 72.8% of the dimethyl sulfide, and 89.9% of the sulfur dioxide were trapped. When black lye was used as the wetting agent in an oxidation tower, no odor of sulfur-laden gases was detectable.

16447

Tamm, O. M. and E. M. Vasil'eva

MEASURES FOR REDUCING ATMOSPHERIC POLLUTION IN CITIES OF THE ESTONIAN SSR. (Meropriyatiya po snizheniyu zagryazneniya atsmofernogo vosdukha v gorodakh Estonskoy SSR). Text in Russian. In: Sanitation Measures Against Air and Water Pollution in the Planning of Cities. (Ozdorovleniye vozdushnogo i vodnogo basseynov gorodov). Government Committee on Civil Building and Architecture (ed.), Lecture series no.2, Kiev, Budivel 'nik, 1968, p.39-40.

Air pollution problems in Estonia center around the cities of Tallinn and Kohtla-Jarve. A paper and pulp plant, a sulfuric acid plant, a mineral-enriching installation, and a shale processing combine are cited as major air pollution sources in the Kohtla-Jarve area and some of the measures taken to control these sources are mentioned. Control measures widely instituted in the country include: conversion to gas and liquid fuels, the use of central heating plants, removal from the cities of large pollution sources such as asphalt-concrete plants, and the closing of installations which do not lend themselves to air pollution control (e.g., the stone crushing facility at the Tallinn concrete plant, and the asphalt-concrete plant at Toyl).

16647

Von Rosenblad, C.

HEAT AND SO2 RECOVERY WITH AND WITHOUT HEAT EXCHANGER. (Waermeund SO2-Rueckgewinnung mit und ohne Waermeaustauscher). Text in German. Zellstoff Papier, 19(4):205-209, April 1939.

The direct and indirect system of liquor preheating for the recovery of sulfur dioxide and heat in a sulfite cellulose plant is discussed. With the direct method, heating and concentrating the acid are carried out at the same time. The waste gases enter the cold acid immediately after cooking at low pressure without intermediate cooling. Large acid tanks are needed and the time for the final gas discharge is long. With the indirect method, the cold acid is concentrated with cooled waste gases and heated indirectly with the heat liberated by the final gas discharge from the digester. The advantage of this method is that no pressure must be applied and less SO2 gas is lost, since the cold acid absorbs more. The amount of heat liberated at the cooking is determined by the final temperature in the digester. If the latter is 132 C, the acid can be heated to 70 C. In case a higher acid temperature is desired, fresh steam must be added. A plant operating according to the latter principle is described and illustrated.

16681

Willet, Howard P.

PROFIT ORIENTED SYSTEMS FOR POLLUTION CONTROL. American Institute of Chemical Engineers, New York, N. Y., American Inst. of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y., American Society of Civil Engineers, New York, American Society of Heating, Refrigerating and Air Conditioning Engineers, New York, American Society of Mechanical Engineers, New York, and American Society for Testing and Materials, Philadelphia, Pa., Proc. MECAR Symp., Design and Operation for Air Pollution Control, New York, N. Y., 1968. p. 75-85. (Oct. 24).

The development of pollution control systems that provide an economically profitable return on control costs is described; it is believed that such processes will enhance control activities by establishing an economic incentive to add to the public pressures on polluters to install control equipment. Profit-oriented control systems are described for blast furnaces and the basic oxygen processes in steel fabrication, for foundry cupolas, kraft pulping, and for sulfur dioxide recovery from power and sulfuric acid plants. Venturi scrubbers, used to clean blast furnace gases, make it possible to obtain higher hot blast temperatures for preheating air blown into the furnaces and thus improve the economics of their operation. Gas take-offs installed below the charging door on foundry cupolas reduce the size of the gas cleaning equipment required and permit the gas to be used as fuel for preheating air blasts to the cupolas. A new method recently introduced from Japan, called the OG Process, has a great profit potential in its application to the basic oxygen process in steel-making, primarily by collecting carbon monoxide without combustion. A series of pollution control techniques can be applied to the kraft pulping process to reduce capital and operating costs. An absorption system to eliminate SO2 pollution from sulfuric acid plants and to increase plant profits is nearing completion, and a concept called the Central Processing Approach is described, involving the establishment of central processing plants, to permit the profitable recovery of elemental sulfur from the sulfur oxide emissions of both large and small power producers.

16695

Jones, William P.

DEVELOPMENT OF THE VENTURI SCRUBBER. Ind. Eng. Chem., 41(11): 2424-2427, Nov. 1949. 4 refs.

The practical application of the venturi scrubber to the removal of dusts, mists, fumes, odors, and smoke from gas streams is discussed. Factors affecting the scrubbing efficiency of a venturi are the velocity of the gas in the throat, the ratio of liquid to gas, and the distribution of liquid in the throat. Of these variables the first two have an appreciable effect on the pressure drop across the scrubber. Most of the power required for operation is expended in the gas pressure drop, which will vary with the amount of liquid used. In general, increased throat velocity results in higher scrubbing efficiency with less liquid, and with somewhat less pressure drop and fan power. A commercial venturi unit at a pulp and paper mill is recovering 7-10 tons of sodium compounds per day from fumes containing particles from below 0.1 to 1.5 micron. Installations on open hearth steel furnaces are achieving 97-99% efficiencies in removing smoke particles from 0.05 to 0.33 micron. Pilot plant studies indicate that the venturi scrubber has a removal efficiency of 98-99.8% for sulfuric acid mists and a 99.9% efficiency for coarse dust from blast fur- [illegible]

16698

Whitney, Roy P., S. T. Han, and J. Lawlor Davis

ON THE MECHANISM OF SULPHUR DIOXIDE ABSORPTION IN AQUEOUS MEDIA. Tappi, 36(4):172-175, April 1953. 12 refs. (Presented at the 38th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 16-19, 1953.)

The absorption of sulfur dioxide in packed towers is discussed in terms of the two-film theory according to which resistance to transfer is concentrated in a gas fluid film and a liquid fluid film in contact at the gas-liquid interface. The two phases are assumed to be in equilibrium; the equilibrium relation is the solubility of the gas in the liquid. It is shown that in systems pertinent to the pulp and paper industry, the absorption mechanism varies greatly with the character of the absorbent. Both film resistances play an important part in the sulfur dioxide-water system. In a sulfur dioxide-sodium carbonate solution where the stoichiometric ratio of absorbed sulfur dioxide to sodium carbonate is never more than 50 mole percent, the absorption rate is controlled by the gas film resistance. When the stoichiometric ratio is increased to a maximum of 120%, liquid film resistance becomes important as conversion proceeds. In sodium bicarbonate and sodium sulfate solutions, the controlling resistance also shifts toward the liquid film. Also discussed are the coefficient values to be used in calculating the required packed height for three conversion stages: the conversion of hydroxide or carbonate to sulfite, the conversion of sulfite or bicarbonate to bisulfite, and the build-up of free sulfur dioxide.

16729

Thoen, G. N. and G. G. DeHaas

RECOVERY FURNACES OPERATED WITH CONTINUOUS SULPHUR ANALYZER. Paper Trade J., 153(19):61-62, May 12, 1969.

A continuous analyzer used for measurement of SO2 and reduced sulfur compounds was tested on a 350 tn/d black liquor furnace. The system had a sensitivity of better than 5 ppb of H2S based on 700 F flue gas analysis. It was found that steam and reduction of smelt were a first order function of reduced sulfur compounds in the flue gases. Some examples of adjustments made in the system are given.

16744

Hawkins, Gerald

SCRUBBER LICKS TOUGH FUME PROBLEM. Plant Eng., 23(13):70, June 26, 1969.

In the production of pulp by the kraft process, black liquor evaporators are a low-volume, highly concentrated source of air pollution. A noncondensable gas scrubber system to be used at the end of an evaporator train is described. Non-condensable gases leave the surface condenser, pass through a pre-cooler, into and through two jets and then into the gas scrubber system. A weak solution from causticizing production is used as a scrubbing medium. Typical performance is: H2S at the inlet 428 lb/day, at the outlet 1 lb/day; CH3SH 438 lb/day at the inlet, 2 lb/day at the outlet.

16747

Clement, J. L. and J. S. Elliot

NEW KRAFT RECOVERY BOILER DESIGN ELIMINATES UNPLEASANT ODOR. Paper Trade J., 153(16):63-65, April 21, 1969. 5 refs.

The use of multiple effect evaporators in place of direct-contact evaporators in kraft recovery boilers results in the elimination of most of the unpleasant odors associated with this process. In this new boiler design, unoxidized black liquor supplied directly from the multiple effect evaporator to the furnace is burned with complete combustion of malodorous compounds. A large bare tube economizer to cool combustion gases to a final stack temperature of 350 to 400 F is incorporated into the new design. Increased SO2 emission and changes in electrostatic precipitator operation are among the effects of the new design that are discussed. Well accepted in the Scandinavian countries, the new system is just being introduced into the U. S.

16807

Roberson, James E.

EFFECT OF RECOVERY ODOR CONTROL ON A KRAFT MILL ENERGY BALANCE. Paper Trade J., 153(34):86-89, August 25, 1969. 2 refs.

In the U. S., kraft pulping accounts for approximately 75 percent of the total U. S. chemical pulp production. From an air emission standpoint, odor reduction is a significant consideration in the kraft process. The energy balances associated with various odor control systems are discussed. Since each mill situation is unique, capital cost, operating cost, and acceptable emission levels must all be considered before arriving at a total evaluation of a recovery odor control system. The energy costs discussed are based on new recovery and multiple effect evaporation installations and assume that the turbine generator condenser is not operating at minimum condensing load.

16824

Malarkey, E. J. and C. Rudosky

WHAT CAN BE DONE ABOUT RECOVERY BOILER SNOWING. Paper Trade J., 153(28):58-60, July 14, 1969.

Many pulp mills find that they have a recovery boiler air-solids pollution control problem, even though the boilers are equipped with electrostatic precipitators guaranteed for collection efficiencies as high as 99%. The sporadic discharge of white flaky salt cake particles, or 'snowing', occurs most often when normal changes in operating conditions cause or permit puffs of particulate discharge even from a precipitator of high average efficiency. Electrode rapping done to dislodge material from collecting electrodes, electrical sparking, and soot blowing are examples of points in the operation where puffs of salt cake particles can escape. Precipitators can be designed to eliminate snowing. Lower gas velocity, sectionalization of electric circuitry, and careful sequencing of electrode rapping elements are among the design elements that must be considered.

16842

Walther, James E. and Herman R. Amberg

A POSITIVE AIR QUALITY CONTROL PROGRAM AT A NEW KRAFT MILL. J. Air Pollution Control Assoc., 20(1):9-18, Jan. 1970. 3 refs.

In the design of the Crown Simpson bleached kraft mill at Fairhaven, California, the latest technological developments in odor and dust control were used to design a system capable of removing in excess of 90% of the malodorous sulfur emission and more than 98% of the dust load. The odor control system consists of high-efficiency black liquor oxidation, noncondensible gas burning, and stripping of 'foul' condensate followed by burning of the off-gases. The dust control system on the recovery furnace consists of a high-efficiency electrostatic precipitator followed by wet scrubbers. The lime kiln gases are scrubbed in a Venturi scrubber and the smelt dissolver stack is equipped with demister pads. The gases from the lime kiln, power boiler, recovery furnace, and black liquor oxidizer are combined and discharged through a 310-ft. stack. A complete emission inventory has been conducted and the volume, composition, and quantity of materials discharged are presented. (Author's Abstract)

16876

Clement, J. L. and W. L. Sage

AMMONIA-BASE LIQUOR BURNING AND SULFUR DIOXIDE RECOVERY. Tappi, 52(8):1449-1456, Aug. 1969. 23 refs.

The use of ammonia-base for sulfite pulping requires consideration of waste liquor burning and sulfur dioxide combustion product recovery. Burning tests in a pilot unit demonstrate liquor can be burned at stable combustion conditions without supplementary fuel where the solids content of the liquor exceeds 50% and air temperature 550 F, and establish parameters for the projected design of a commercial liquor atomizer and water-cooled furnace to burn ammonium liquor. Reported SO2 absorption experience provides information to design a system for SO2 recovery at a temperature of about 100 F; more economical design at the flue gas dewpoint temperature requires additional knowledge of the effect of temperature on absorption system parameters. (Author's Abstract)

16899

Aho, William O.

THE JENSSEN EXHAUST SCRUBBER--AN EFFECTIVE AIR PROTECTION SYSTEM. Tappi, 52(4):620-623, April 1969. 5 refs.

A system incorporating a bubble cap tray absorption column was designed and installed to recover SO2 from two Jenssen tower exhausts. With this system the exhaust gases are scrubbed with a sodium hydroxide--sodium bisulfite solution, and the resulting liquor is used in a neutral sulfite--chemimechanical pulping process. Potential problems stemming from SO3, and CO2 in the gases were evaluated. Other types of scrubbers were examined. The design procedure for the scrubber is reviewed and a description of the recovery process is included. Both a source of air pollution and economic loss were eliminated. (Author's Abstract)

17088

Semrau, K. T., C. W. Marynowski, K. E. Lunde, and C. E. Lapple

INFLUENCE OF POWER INPUT ON EFFICIENCY OF DUST SCRUBBERS. Ind. Eng Chem., 50(11):1615-1620, Nov. 1958. 21 refs.

The total power-input method of correlation as suggested by Lapple and Kamack has been applied to the following three types of pilot plant scrubbers: venturi, cyclonic spray, and pipeline. The procedure is described and supporting data are given. It is concluded that the venturi and cyclonic spray scrubbers and the combination of the two give substantially the same efficiency on a given aerosol when operated under comparable conditions at the same total power input (expressed as theoretical power input per unit of gas flow rate). The pipeline scrubber, using hot water, gives lower efficiency on recovery furnace fume than the other units. It is believed that this difference was due to condensation effects rather than equipment characteristics. This interpretation is supported by literature data. The venturi, cyclonic spray, and pipeline scrubbers gave comparable deficiencies on lime kiln dust and fume when operated at the same power input, but the precision of the data was not sufficient to reveal possible small differences in performance. Available literature data on efficiency of scrubbers on recovery furnace fume showed good agreement with data of this study.

17177

HIGH SCORE IN AIR/WATER QUALITY SET BY AMERICAN CAN KRAFT MILL. Paper Trade J., 154(11):46:53, March 16, 1970.

A 300 ton per day kraft pulp and tissue mill in Oregon is an outstanding example of the use of advanced techniques for controlling air and water pollution. Notable success has been achieved in reducing kraft odor to a barely perceptible level, and the mill is meeting Oregon's stringent air and water quality standards. The mill is distinguished from other kraft mills by the absence of a direct contact evaporator in the recovery process. Instead, a three-stage, steam heated concentrator patterned after the conventional six effect Swenson evaporator raises black liquor solids to 62-65% for burning in the recovery furnace. The effect is to eliminate one point where odor formation occurs through contact of hot gases with the black liquor. Another variation from conventional design is the use of a dry bottom electrostatic precipitator. The unit, which eliminates another point of odor formation, is rated at 99.5% efficiency. Chemical and fiber losses throughout the mill are minimized and there are safeguards from accidental spills. Sumps are located on the effluents from the paper mill, pulping and bleaching recovery, lime kiln, and causticizing. The conductivity on each sump is measured and, if the minimum chemical content is exceeded, a pump automatically returns the flow to process. To keep production at the proper levels, and for air and water quality, control instrumentation at the mill is centralized. The approximate cost of the mill's air and water quality systems is $4 million.

17266

Freyshut, Sting

PROTECTION OF NATURE IN SWEDEN – SYSTEM AND RESEARCH. (Sueden ni okeru shizen hogo -- soshiki to kenkyu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(1):13-17, Jan. 1970.

Several new systems developed for Swedish pulp manufacturing plants are detailed. There are some problems existing in the process of stripping, bleaching, and dehydrating solids. Moreover, the waste water from a pulp manufacturing plant contains liquid used for the raw pulp boiling process, fibrous materials, and bark from the bleaching process. The effect of a new system for reducing the amount of waste liquid is illustrated by a multiplex elutriation installation which works for both digestion and filtration. High purification efficiency is decisive in producing pulp of high quality and in this respect a new system of dispersion purification offers the following advantages: an ideal method of pure water supply, adequate time for elutriation, and sufficiently high temperature of the water used for elutriation This dispersion elutriation system is distinguished by a device that excludes outer air and foam generation to attain maximum purification efficiency. In this system, nothing but pulp is disposed to air, there are no odor problems and foaming trouble and, consequently, the initial filter water is able to be recirculated, decreasing fresh water demand for purification by perhaps 80%. This means a reversely proportional decrease of waste water inflow to the settling tank. A problem existing in a kraft plant which produced between 2 and 3 kg mercaptans and sulfuric compounds per one ton of pulp was solved by application of vapor-stripping system in which separated sulfuric compounds and hard-to-thicken gaseous refuse are incinerated; the sulfuric compounds are oxidized by controlling incineration conditions. A cooperative system for industrial pollution involving industry and control officials is briefly outlined.

17409

Walther, J. E. and H. R. Amberg

ODOR CONTROL IN THE KRAFT PULP INDUSTRY. Chem. Eng. Progr., 66(3):73-80, March 1970. 12 refs.

As determined by year-long odor inventories at four West Coast kraft mills, present technology will permit reduction of total sulfur compounds by 90-94%. High efficiency oxidation of black liquor should reduce sulfur emissions from the recovery furnace to about 0.1 lbs/AD ton of pulp. Emissions as low as 0.01 lbs/AD ton of pulp could be achieved by eliminating direct contact of hot flue gas and black liquor in accordance with two new systems. One system relies on concentrating the black liquor in multiple- effect evaporators to the desired concentration for direct firing to the furnace. The other systems use the hot flue gases from the recovery furnace to heat air in a laminar flow heater. This heated air is passed through a conventional cascade evaporator to raise the solids content of the black liquor coming from the multiple-effect evaporators to the concentration desired for firing in the furnace. Burning of noncondensable gases from digesters and multiple-effect evaporators in the lime kiln, recovery furnace, or incinerator is a positive method of completely eliminating this source of odors. The lime kiln can be operated at daily hydrogen sulfude emissions as low as 0.06 lbs/ton of AD pulp. Miscellaneous source odors are the washer hood vent gas, the washer filtrate seal tank gas, and the knotter hood vent gas. Although their concentration is relatively low, the volume of reduced sulfur compounds is these streams can be substantial. This area will require considerable research and development work before a completely satisfactory solution is found.

17559

Nichlin, T. and E. Brunner

HOW STRETFORD PROCESS IS WORKING. Hydrocarbon Process Petrol. Refiner, 40(12):141-146, Dec. 1961. 18 refs.

Results of plant-scale tests are reviewed for the Stretford Process, a method for continuous purification of gas or liquid mixtures containing hydrogen sulfide, which uses an aqueous alkaline solution of sodium salts of anthraquinone disulfonic acids. In the regeneration step, sulfur is precipitated. the plant operation is described, and factors affecting the level of H2S removal, operating costs, and side reactions are discussed. Operating costs are estimated at 21 cents per Btu, most of which is for labor and power; this cost can complete economically with other liquid or oxide purifiers, and does not take into account credit from the sale of by-product sulfur. Although intended originally for the removal of H2S from the coal gas, the method appears to have application to purification of refinery gases, effluent air streams as in the viscose and transparent paper industries, gases rich in carbon dioxide, of crude benzoles and petroleum products containing H2S. Improvement of the method by the use of sodium vanadate is under development. This additive has the effect of speeding the reaction and improving the weight of sulfur produced from a given volume of washing medium.

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17656

Laberge, J. C.

SULFITE MAGNESIUM OXIDE SYSTEM--SULFUR DIOXIDE ABSORPTION EFFICIENCY IMPROVEMENT. Tappi, 46(9):538-541, Sept. 1963. 2 ref (Presented at the Annual Shibley Award Meeting of the Pacific Section, 25th, Everett, Wash., March 19, 1963.)

The reduction of atmospheric sulfur dioxide losses in the exhaust gases from a magnesium-base pulp plant was described. The sulfur dioxide losses were reduced by a factor of 20 without additional capital investment. The sulfur dioxide absorption system consisted of a pair of absorption trains preceded by cooling towers. Each absorption train was designed to absorb the sulfur dioxide from the flue gas of a spent liquor recovery boiler. The towers were hand- packed with 6 in. by 6 in. cross-partition rings. In addition to the flue gases, certain other gas streams enter the absorption system. By reapportionment of the other gas streams, an evaluation of their effects upon the overall absorption efficiency was made. The controlling source of excessive sulfur dioxide loss was then traced to a makeup sulfur dioxide gas stream. The acid recirculation system was then modified to absorb more efficiently the sulfur dioxide from that makeup gas stream. No harmful effects occurred upon the absorption system operation, acid quality, available induced draft, or the operation of the recovery boiler. (Author abstract modified)

18029

Arhippainen, Bengt and Bo Jungerstam

OPERATING EXPERIENCE OF BLACK LIQUOR EVAPORATION TO HIGH DRY SOLIDS CONTENT. Tappi, 52(6):1095-1099, June 1969. 10 refs.

Operating practice in most modern Scandinavian kraft mills includes evaporation of the black liquor to 60-65% dry solids content in multistage evaporators and direct firing of the strong liquor. In most cases, the selection of this system in preference to a direct- contact evaporator system can be justified by economical consideration alone, with no regard to air pollution. Operating experience with multistage evaporation plants operating at high dry solids content is reported. The heat transfer characteristics of black liquors are related to reported physical properties, and the importance of increasing boiling point rise with increasing dry solids content is pointed out. The scaling properties of black liquors at high dry solids content is related to their chemical properties. The importance of maintaining a low temperature in the high dry solids effect, a reasonable content of residual alkali, and low contents of sodium sulfate, carbonate, and fiber in the black liquor, efficient soap separation, and high white liquor clarity, in order to limit scaling, is stressed. It is indicated that the optimum product dry solids content may be higher than the 62-63% presently achieved with natural circulation evaporators, because of favorable secondary effects in the recovery boiler. Some Scandinavian mills use forced circulation in the high dry solids effect, whereby 65-67% dry solids content can be reached. The use of forced circulation in the high dry solids effect is not always justifiable in Scandinavia, but it is assumed that forced circulation should be a first choice in many areas with lower power costs. (Author's Abstract)

18037

Moody, Dennis M.

BLOWPIT GAS RECOVERY WITH A SINGLE BLOW STACK SYSTEM. Tappi, 52(3):448-450, March 1969.

A single blow stack system for the recovery of blowpit vent gases has been designed and installed, replacing multiple wooden blow stacks. It consists of a stainless steel stack connected to the six blowpits by a header system. The stack acts as a scrubbing column, condensing steam and recovering sulfur dioxide from blowpit gases for reuse. The system is designed to operate at high flow rates and low pressure drops. Water is sprayed counter-currently to rising gases over specially designed stainless steel and wood packing. Water flow control is based on gas temperature and pressure. The system is 98% efficient in SO2 recovery and has resulted in both improved SO2 and heat recovery. Exit gases average about 1400 ppm SO2. (Author's Abstract)

18140

Hawkins, Gerald

SCRUBBER LICKS TOUGH FUME PROBLEM. Plant Eng., 23(13):70, June 26, 1969.

Air pollution control with scrubbers at Champion Papers is discussed. To eliminate the low-volume, highly concentrated sulfur-containing pollutants, two gas scrubbers were installed in parallel on two 600-ton black liquor evaporators used in the kraft pulping process. Non-condensable gases leave the surface condensers, pass through a pre-cooler, through jets, and into the gas scrubber. The scrubber's effectiveness is excellent and can easily be evaluated by observing the exhaust vents for plume evidence.

18240

Gessner, Adolf W., Theodore J. Kayhart, and Gordon L. Dibble

APPARATUS. (Lummus Co., New York, N. Y.) U. S. Pat. 3,314,399. 3p., April 18, 1967. 4 refs. (Appl. Nov. 15, 1965, 11 claims.)

This invention relates to a pulping recovery furnace for high sulfur reduction in which the net radiation heat flow between hearth and secondary combustion zones is reduced. Two modifications of the conventional recovery furnace are proposed. First, a refractory obstacle is placed above the hearth zone thereby reducing the net radiation flow and causing additional heat to be available for sulfur reduction. Second, the boiler tubing normally surrounding the hearth zone is removed. Heat normally lost at this point is thereby retained and utilized in the endothermic reduction of sulfites, thiosulfates, and sulfates. The passage of black liquor through the proposed furnace is described in detail.

18262

Hanway, John E., Jr., E. B. Henby, and G. R. Smithson, Jr.

MAGNESIUM-BASE COOKING LIQUIR PREPARATION BY ABSORPTION OF DILUTE SULFUR DIOXIDE IN FLOODED-BED TOWERS. Tappi, 50(10):64A-69A, Oct. 1967. (Presented at the 20th Alkaline Pulping Conference, Tech. Assoc. of the Pulp and Paper Industry, Richmond, Va., Sept. 13-16, 1966.)

The experimental and commercial development of a flooded-bed acid absorber used in connection with a newly developed chemical recovery system for treating magnesium-base sulfite waste effluents is described. The chemical recovery system involves the oxidation of the organic matter in the waste effluent in a fluidized-bed furnace and decomposition of the magnesium-sulfur complexes into granular magnesia and gaseous sulfur dioxide. The granular magnesia is used to prepare a magnesium hydroxide slurry for use as the absorbing medium to recover the sulfur dioxide present in relatively low concen-

trations (1.0 to 1.5 vol.%) in the exhaust gas and to produce a magnesium-base sulfite cooking acid. The type of acid-absorbing tower used is unique and its experimental development is described. The extrapolation of these data to commercial use in a 200-ton/day magnesium-base sulfite mill is covered. The development provides a simple but very efficient method for regenerating cooking acid from magnesium-base waste pulping effluents. Its potential may well cause an increasingly accelerated change within the next several years to magnesium-base sulfite pulping. (Author abstract modified)

19071

Bunyard, F. L.

POLLUTION CONTROL FOR THE KRAFT PULPING INDUSTRY: COST AND IMPACT. Preprint, Air Pollution Control Association, New York City, 25p., 1970. 5 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., 1970.)

The Clean Air Act, as amended, requires comprehensive studies of the economic impact of air quality standards on the nation's industries and other contributing sources of pollution. Such information is needed to estimate the cost of compliance that may be required to meet ambient air quality or emission standards. An economic appraisal of the pulping industry's efforts to meet these standards is presented. Expenditures by the industry for control equipment for a recent year are given. Types of equipment employed to control sulfur dioxide, hydrogen sulfide, and particulates include scrubbers, packed towers, precipitators, catalytic oxidation units, and power boiler mechanical collectors. An analysis predicting control costs for building new, modern mills and for upgrading existing mills to comply with Oregon's 1975, particulate and total reduced sulfur emission standards for the kraft recovery process shows that the cost of this level of control will be about $0.16 per ton in new mills and about $2.00 per ton for existing mills. The thrust of the Oregon standards, as shown by the impact analysis, will be directed toward controlling emissions from the direct-contact evaporator and black liquor combustion furnace system. The financial requirements for air pollution control to comply with Oregon's emission standards are reviewed in terms of profitability and capital investments. For an individual 600 ton-per-day mill, investment for upgrading the facility would be approximately $2 million.

19216

Tomogama, T. and Masahiko Asai

O-K TYPE SCRUBBER FOR SODA RECOVERY BOILER. (Soda kaishu boira yo O-K gata sukuraba ni tsuite). Text in Japanese. Kami-Pa Gikyoshi (Journal of the Japanese Technical Association of the Pulp and Paper Industry), 24(7):366-368, July 1, 1970.

The O-K type scrubber was developed for treating the exhaust gas from the soda recovery boiler. The quantity of falling dust can be reduced by collecting the larger dust in the exhaust gas. Therefore, a model plant of a cyclone scrubber was constructed which has a comparatively simple structure. Its performance was examined for about 8 months. On the basis of the data, a practical O-K-I type scrubber was constructed, and it attained the desired effect. Exhaust gas passes from the electrical dust collector to the O-K-I type scrubber and dust is removed by a cyclone effect after it is collected by water drops. About half of the black liquor is water and steam in the exhaust gas and contains a large quantity of latent heat. To use the heat sufficiently, the gas temperature must be lower than the dew point, about 70 degrees. However, due to a technical problem, the temperature of the tail gas is usually about 150 degrees. By using the scrubber, the temperature of the tail gas is lowered to 60 degrees.

19218

Nakajima, Shinichi

ACCIDENT PREVENTION AND COUNTERMEASURE FOR PUBLIC NUISANCE OF RECOVERY BOILER. (Kaishu boira no jiko boshi narabini kogai taisaku ni tsuite). Text in Japanese. Kami-Pa Gikyoshi (Journal of the Japanese Technical Association of the Pulp and Paper Industry), 24(7):351-355, July 1, 1970. Locomotive Manufacturing Co. (Japan).

The kraft pulp recovery boiler has more difficulties than the boiler using only heavy oil as fuel. Public nuisance is also one of the pressing problems of the day. The slight accidents that prevent continuous operation are due to corrosion of the superheated tube or leaking of the smelt. Corrosion can be avoided by using a suitable material for the wall of the tube and by maintaining a uniform wall temperature. The serious accidents accompanied by an explosion in the furnace occur through a smelting-water explosion or an explosion of the sub fuel. The former is avoided by preventing the black liquor from becoming thin and by preventing cooling water from flowing into the furnace. The latter is avoided by preventing the fire from going out. The development of a dust collector has solved the problems of smog, but offensive odor is still a problem. The principal components of the offensive odor are hydrogen sulfide and methyl mercaptan. They are emitted by the direct contact evaporator and the combustion room. Therefore, facilities without a direct contact evaporator must be established. There are two kinds of facilities without a direct contact evaporator; one has been developed in the U.S.A. and another in Scandinavia. The latter is considered to be more effective than the former. Even if the direct contact evaporator is not used, offensive odor is generated when combustion of black liquor is incomplete. The method developed by a corporation in Sweden was adopted.

19257

Maeda, Isamu and Nobuo Ito

AN APPARATUS FOR THE CONTINUOUS RECOVERY OF SULFUR OXIDES IN FLUE GAS. (Haigasu chuno iosankabutsu renzoku kaishusochi). Text in Japanese. (Sumitomo Machine Industries, Osaka (Japan)) Japanese Pat. Sho 45-2644. 2p., Jan. 29, 1970. (Appl. April 28, 1967, claims not given).

An improved conventional method of recovering sulfur oxides from flue gas is presented which can be applied to flue gas from boilers, smelting or metal-sintering processes, or pulp manufacturing. Since the sulfur oxides concentration in flue gas is extremely low and volume of flue-gas to be processed is extremely high, the gas was previously passed through absorbents from which the sulfur oxides were recovered. The process required rinsing with inert gas, H2, CO, water, or alkaline solutions. Consequently, generators and circulators for those gases and liquids were necessary. In the present process, however, the major part of the flue gas is cooled to the temperature appropriate for adsorption and subsequently led to a continuous adsorption apparatus, where the sulfur oxides are adsorbed. The remainder of the gas by-passes the cooling chamber. After the removal of the remaining oxygen, the gas is led to a de-adsorption chamber and sulfur oxides are recovered. The system requires no inert-gas generators or gas heaters. Moreover, since a moving-layer adsorption system is empolyed, less adsorbent is needed. Also, the concentration of the recovered gas is more uniform than that covered by previous processes.

19425

Bonsall, R. A.

CHART GIVES SOLUBILITY OF SO2 IN AMMONIUM BISULFITE. Chem. Eng., 68(10):182,184, May 15, 1961.

A chart which gives the solubility of sulfur dioxide in ammonium bisulfite is described. The chart was designed for the pulp and paper industry, but is valuable for other applications. Data on the solubility of SO2 in ammonium bisulfite solutions show that the vapor pressure of SO2 is directly proportional to the concentration of what can be described as the true free SO2; the total SO2 in solution minus that which can be combined with the base as the bisulfite. Plotting SO2 vapor pressure against true free SO2 concentration, and then superimposing a temperature curve on the graph, makes it possible to find any given variable knowing the other two. The points above 25 C were extrapolated by plotting the log of SO2 vapor pressure against the reciprocal of absolute temperature at several values of true free SO2 concentration.

19733

Shibler, B. K. and M. W. Hovey

PROCESSES FOR RECOVERING SULFUR FROM SECONDARY SOURCE MATERIALS. Bureau of Mines Information Circ., no. 8076, 1962, 62p. 561 refs.

A literature survey on processes for recovery of elemental sulfur and sulfur compounds from secondary source materials is presented, and the more important processes from all non-Frasch sources are described. The text consists of concise descriptions of the general nature of the recovery processes and definitions of major differences between processes proposed for treating the same or similar materials. The bibliography represents the available English language literature on the subject through 1958, with emphasis on the period 1950-1958. In addition to several articles and publications containing general information on sulfur, the text and bibliography on processing methods are arranged under the six principal sources of secondary sulfur, as follows: volcanic sulfur, including all elemental sulfur deposits not adaptable to the Frasch mining process; hydrogen sulfide as found in sour natural gases, petroleum refinery products, and coke-oven gases; sulfur dioxide from the roasting and smelting of metal sulfide ores and from power plant waste gases; pyrite and pyrrhotite obtained by mining mineral deposits or produced as by-products from the concentration of sulfide ore; gypsum and anhydrite occurring as deposits of calcium sulfate; and industrial wastes containing sulfates, sulfites, and sulfuric acid, such as those produced in the steel, paper, and petroleum industries. (Author summary modified)

19916

Canovali, L. L. and S. Suda

CASE HISTORY OF SELECTION AND INSTALLATION OF A KRAFT RECOVERY ODOR-REDUCTION SYSTEM. TAPPI, 53(8):1488-1493, Aug. 1970. 11 refs. (Presented at the Conference of the Technical Association of the Pulp and Paper Industry, Alkaline Pulping, Jacksonville, Fla., Oct. 14-17, 1969.)

The reasons behind the selection of certain pollution control equipment for a kraft recovery odor-reduction system are presented. The processes responsible for the various emissions are discribed, and the principles of operation of the control equipment and control processes are discussed. The pollutants of concern are hydrogen sulfude, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. The primary considerations in designing the control system involved elimination of the direct-contact evaporator and burning of unoxidized black liquor directly in the kraft recovery furnace. A lime kiln and chemical recovery unit are provided to incinerate malodorous gaseous compounds from all mill sources, with an electrostatic precipitator to control particulates.

19930

Yemchuk, E. M.

OXIDATION OF BLACK LIQUOR AT THE GREAT LAKES PAPER COMPANY LTD. Pulp Paper Mag. Can. (Quebec), 71(14):45-50, July 17, 1970. 4 refs. (Presented at the Canadian Pulp and Paper Association, Technical Section, Midwest Branch, Thunder Bay, Ontario, 1969, Paper T299.)

Associated with any kraft mill industry is the odor of sulfide gas emitted from the recovery stack. Economically, the emissions represent a direct loss of the valuable sulfur element used in the kraft pulp cooking process. Sulfide losses can be reduced by oxidation of black liquor. The history of a black liquor oxidation system now in operation is reviewed. The system oxidizes black liquor by forcing air through towers flooded with liquor. Foam is produced and then broken back down into liquor. Various design difficulties encountered in eliminating the foam are described. With the present two stage system, oxidation efficiencies in excess of 90% are reached, reducing the sodium sulfide concentrations from 12 g/l to approximately one g/l.

20143

Semrau, Konrad T.

CORRELATION OF DUST SCRUBBER EFFICIENCY. J. Air Pollution Control Assoc., 10(3):200-207, June 1960. 27 refs. (Presented at the Air Pollution Control Association 52nd Annual Meeting, Los Angeles, Calif., June 22-26, 1959.)

In an effort to elaborate on a design theory for scrubbers and to relate the basic mechanisms of particle deposition to measureable performance variables, an empirical method for correlating scrubber efficiency as a function of the power dissipated per unit of gas flow rate (contacting power) is applied to literature data for a variety of aerosols and scrubbing equipment. The theoretical relationships are developed in general, and are then worked out for talc dust, copper sulfate aerosol, ferrosilicon furnace fume, phosphoric acid mist, open hearth furnace fumes, foundry cupola dust, odorous mist, black liquor recovery furnance fume, and blast furnace dust and fume. In all cases, the number of transfer units may be represented by a simple exponential function of the contact power. Efficiency has little relation to scrubber design and geometry, but is dependent on the properties of the aerosol and on the contacting power. The data specifically support earlier observations that contacting power derived from hydraulic spray nozzles is equivalent to that derived from gas pressure drop.

20258

Brink, David L., Jerome F. Thomas, and Kay H. Jones

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. III. A RATIONALE FOR CONTROLLING ODORS. Tappi, 53(5):837-843, May 1970. 12 refs. (Presented, in part, at the Technical Association of the Pulp and Paper Industry, Annual Meeting, New York, Feb. 1967.)

Studies of batch and steady-state pyrolysis in kraft black liquor combustion are summarized and pertinent differences are discussed in a series of experiments covering a temperature range from 400 to 1135 C. A many-fold increase in the volume of uncondensed gases formed in the higher temperature ranges, and the composition of these gases, are presented as evidence for the occurrence of extensive gasification of carbonaceous residues by the steam-char reaction under steady-state conditions. This reaction is significantly reduced under batch conditions. In the lower temperature ranges, a high percentage of the sulfur present in the black liquor is converted to an array of at least 57 different sulfur-containing malodorous products. Under steady-state conditions, these products are decomposed as temperature is increased with only small amounts remaining above 1000 C. A summation of the calorific values of the major steady- state pyrolysis products isolated from black liquor solids shows the overall system to be endothermic. The significance of the study with respect to furnace operation and associated problems, especially odor emission and its abatement, are discussed, and a conceptual basis for designing a pyrolysis-combustion system employing multistage pyrolysis is suggested.

20286

Flynn, Charles S.

AIR PURIFYING APPARATUS AND METHOD. (Assignee not given.) U. S. Pat. 3,497,308. 5p., Feb. 24, 1970. 4 refs. (Appl. July 22, 1968, 6 claims).

A combustion apparatus and method for burning waste fluids, particularly combustible vaporous and gaseous fluids from the kraft pulping processes, are described. A particular burner and manifold are employed in a stack. The burner permits hot combustion gas to flow past the manifold jets through which the combustible gases are ejected at a high velocity. The burner combustion gases extend over a large area using a refractory felt dissipator and combustion surface. The gases are sucked out of the generating vessel zone and forcefully discharged through the manifold jets adjacent to the burner at a velocity far exceeding the flame propagation rate of any of the combustibles, preventing flash-back into the kettle or other vessel. The gases thus pass to the atmosphere in a purified form. The details of the method, and the construction and arrangement of the equipment, are discussed.

21051

Roberson, James E.

THE EFFECT OF ODOR CONTROL ON A KRAFT MILL ENERGY BALANCE. J. Air Pollution Control Assoc., 20(6):373-376, June 1970. 3 refs.

Thirteen different recovery unit odor control cases are analyzed to determine the variation in energy costs for a kraft mill. Incineration or scrubbing is often used to reduce odors, except for the recovery unit which is the greatest offender. Oxidation or removal of the direct contact evaporator appears to be the most reasonable method of reducing the odorous emissions of hydrogen sulfide. New recovery systems, which eliminate the direct contact of flue gas and black liquor, have several variables that affect energy costs: steam coil air heaters, recirculating air heaters, regenerative air heaters, 55% to 60% solid evaporators, and large economizers. These variations are calculated and presented as energy balances, indicating that engery costs for various odor control systems are of sufficient value to be considered during evaluations. The newer recovery systems have the lowest expected fuel cost as well as significant chemical cost savings. Capital costs, fuel costs, and acceptable emmission levels should all be considered before arriving at a total odor control system evaluation.

21369

Ahlgren, Per, Sven Lemon, and Ants Teder

PREPARATION OF SODIUM POLYSULFIDES BY SOLID AND MOLTEN STATE REACTIONS. Acta Chem. Scand., 21(4):1119-1120, 1967. 7 refs.

Polysulfides were obtained from the sodium-sulfur compounds (Na2SO4, Na2S, and N12S203) available in the recovery system of a kraft pulp mill by thermal decomposition of thiosulfate, partial oxidation of sulfide, and by partial reduction of sulfate. The reactions were performed at elevated temperatures in the absence of water, at atmospheric pressure, and at restricted air contact. To prevent their partial decomposition to sulfate and sulfide, the polysulfides were cooled before dissolution in water. Thiosulfate decomposed to polysulfate and sulfate when heated to above 450 C in a pyrex vessel. On heating at 550 C for 15 min, the yields of sulfide and polysulfide excess sulfur were 11.3% and 47.2%, respectively. Partial reduction of sulfate and partial oxidation of sulfide at 900 C in the presence of carbonaceous material yielded polysulfide and carbonate. Both reactions were carried out in zirconium dioxide or carbon crucibles. The yields obtained at 900 C for both reactions are tabulated.

21407

Kato, Yujiro

PLANS AND OPERATIONAL EXAMPLES ON FILTER TYPE DUST COLLECTOR SYSTEM AT VARIOUS INDUSTRIES (VII). THE ROLE OF BAG FILTERS IN VARIOUS INDUSTRIES. (Gyoshubetsu ni miru rokashiki shujin sochi no keikaku to unten jisshirei (VII). Kakushu kogyo ni okeru baggu firuta). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(12):803-808, Dec. 15, 1968.

Factors contributing to the efficiency of bag filters are summarized and additional instances of their industrial applications are presented. An example of a baghouse employed by the food industry controls emissions from pneumatic conveyors for cornstarch. The operation of a typical unit is described. Bag filters are also utilzied to reduce the aerosols produced by fermentation processes. In the paper industry, there are a few processes in which powdered materials are handled, e.g., casting terra alba and talc in a dissolving bath. A baghouse for controlling emissions from such a process is described. In the medical supplies industry and in the cosmetics industry, bag filters are used for various processes. Cited as an example is the baghouse equipped for collecting emissions from the last stage of cosmetics production. Other industries mentioned are cable and the coke manufacturing. A baghouse equipped for controlling emissions from the steam-heating exhaust is also noted. In conclusion, the function of bag filters depends on three factors: filtering efficiency, the lifetime of the filter fabric, and filter resistance. Filters function most effectively when these three factors are harmonized and when appropriate cleaning methods are employed.

21960

Spalding, C. W. and S. T. Han

ABSORPTION WITH CHEMICAL REACTION FROM A DILUTE GAS IN PACKED TOWERS. TAPPI, 45(3):192-199, March 1962. 28 refs. (Presented at the Engineering Conference of the Technical Association of the Pulp and Paper Industry, 16th, Washington, D. C., Oct. 16-19, 1961.

The absorption of a dilute component of a gaseous mixture by chemical reaction in a liquid is reviewed on the basis of both the film and the penetration theories. The design procedure and operating characteristics of packed towers are discussed in the light of the theories and illustrated with the sulfur dioxide-water and sulfur dioxide-sodium hydroxide-water systems. The fundamentals of interphase mass transfer are reviewed. Concern over air pollution and chemical costs has led the pulping industry to consider the removal of many compounds from exhaust gases. (Author abstract modified)

21965

Rickles, Robert N.

WASTE RECOVERY AND POLLUTION ABATEMENT. Chem. Eng., vol. 72:133-152, Sept. 27, 1965. 112 refs.

Various methods presently available for the treatment of liquid and gaseous effluents were discussed. Methods and processes that have been used or proposed for the recovery of valuable products were stated as follows: biological oxidation, biological reduction, and chemical oxidation; sedimentation tanks, thickness, flocculation tanks, cyclones, centrifuges, screens, filters, and membrane sieves; foaming and flotation; adsorption; ion exchange; membrane processes solvent extraction; and evaporation and crystallization. The extent of participation of the various segments of the chemical processing industry in the abatement/by- product recovery program was illustrated by specific examples from the petrochemical industry, coal and coke industry, phosphate fertilizers, petroleum industry, and pulp and paper industry. The extent of government involvement, both federal and state, was brought out by listings of federal R&D agencies, state programs of air and water pollution control, state assistance provided for waste treatment facilities, and key provisions of proposed legislation in the area of tax relief to companies buying control or abatement equipment. The prediction was made that when public and governmental pressure becomes great enough, industry will find a way to make a profit out of waste control.

21983

Parkison, Robert V.

THE ABSORPTION OF SULPHUR DIOXIDE FROM GASES OF LOW CONCENTRATION. TAPPI, 39(7):522-527, July 1956. 13 refs.

Absorption experiments are reported on three systems: (1) oxygen-water; (2) high-concentration (5 to 16%) sulfur dioxide-water; and (3) low-concentration (0.5 to 1.5%) sulfur dioxide-water. The low concentration range is encountered in the flue gases from recovery furnaces burning spent pulping liquor. The absorbing medium was water in packed towers. The results are expressed in terms of over-all coefficients, which would be an adequate design criterion. The low-concentration and the high-concentration coefficients should be in agreement at high gas rates, with the low-concentration coefficients showing a stronger function of gas rate and being significantly lower at low gas rates. The desorption coefficient for the oxygen-water system is not a function of gas rate. The results are discussed in terms of existing absorption theories.

22061

Akamatsu, K.

OZONE OXIDATION OF DIMETHYL SULFIDE AND DEODORIZING OF KP BLOW-GAS. (Jimechiru sarufaido no ozonsanka to KP burogasu no mushuka ni tsuite). Text in Japanese. Kami-pa Gikyoshi (J. Japan Tech. Assoc. Pulp Paper Ind.), 22(4):200-204, April, 1968. 7 refs.

The main cause of obnoxious odor from kraft pulping (KP) is in the sulfur compounds that arise in the process. Sulfur compounds in reduced form are odoriferous whereas those in oxidized form are either odorless or just irritants. Tables are presented on the amount of dimethyl sulfide (DMS) that can be retrieved from KP black liquor at various temperatures and with different amounts of Na2S added. Different quantities of organosulfur compounds released in KP of different types of trees are listed for various pulping conditions. In general, the broad-leaved trees yield more odorant substances than do the coniferous trees. The data were obtained by a process similar to the theoretical method, and the quantity of organosulfur compounds from real KP process is probably much smaller. The gaseous sulfur loss balance sheet for two factories in the South (U. S.) show that most of the sulfur released is in the H2S emitted from the recovery furnace, followed by sulfur dioxide gas and DMS. A brief description of a process for deodorizing DMS by ozone oxidation is given. However, unless inexpensive methods are found for the production of ozone, the method is still far from application.

22357

Fernandes, J. H.

ELIMINATION OF ODORS AND DUSTS CREATED BY THE COMMUNITY AND BY INDUSTRY. (L'eliminazione degli odori e delle polveri provocate da comunita e industrie). Text in Italian. Inquinamento, 12(3):27-35, 1970.

The various processes are reviewed by which odors and dust particles in the atmosphere can be reduced or eliminated. Reference is made to an extensive series of studies by the Air Preheater Company, which has developed an odor-eliminating device known as Cor-Pak, which eliminates disagreeable vapors by burning them in a flame. Odors can also be reduced by wet processes and by oxidation with a catalyst. Special attention is given to the elimination of odors from a paper mill and from incinerators where solid waste is burned. Included in the discussion of dust removal is a discussion of cyclones, scrubbers, electrostatic precipitators and the various types of filters. Cyclones are effective with dust particles of 20 micron or larger. Electrostatic precipitators require a voltage of 50,000-100,000 V. On the other hand, the pressure drop is only about 2.5 12 cm H2O, and the dust collecting efficiency is better than 99%. Particles of less than 1 micron are captured just about as readily as those 100 micron in size. Although bag filters are highly efficient (99.9% dust removal), the cost of installation and of replacing the bags is a serious drawback to their extensive use.

22400

Vedernikov, V. G. and V. F. Maksimov

SOME PROBLEMS IN THE DEODORIZATION OF GAS DISCHARGES IN THE SULFATE-CELLULOSE INDUSTRY. (Nekotorye voprosy dezodoratsii gazovykh vybrosov sul'fatno-tsellyuloznogo proizvodstva). Tr. Tsellyul. Bum. Prom., vol. 13:148-154, 1964. 10 refs. Translated from Russian. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 13p., Nov. 11, 1969.

The use of uncondensed exhaust gases as a deodorizing agent in the sulfate-cellulose industry is discussed. Mercaptan and hydrogen sulfide trapping methods are described. A sulfane production system which employs condensation, scrubbing, absorption, and a methanol bath is considered. Experiments with black liquor oxidation are conducted in an attempt to solve deodorizing problems. The industrial method of obtaining dimethylsulfoxide from the toxic sulfur-containing discharge dimethylsulfide is discussed. Gases uncondensed by water discharged by the digestion works must be combined and directed into an absorption chamber. On evaporation of black alkalies, H2S and methyl mercaptan are isolated as a consequence of the hydrolysis of sodium sulfide and sodium mercaptide contained in the black alkali. Deodorization in the soda section with an electrofilter and a scrubber is feasible, but requires corrosion resistant conduit.

22522

NOW...RECOVERY BOILERS CONTROL ODOURS. Mod. Power Eng., 64(7): 50-53, July 1970.

A recovery boiler which controls the odors emitted by a kraft pulping plant is described. The new type of unit features a design eliminating any contact between odor bearing black liquor and cool stack gases, preventing the escape of odors to the atmosphere and minimizing the odor problems associated with conventional black liquor chemical and heat recovery boilers. The new boiler design uses multiple-effect evaporators to concentrate the liquor to 65% solids, suitable for direct firing in the boiler. Heat recovered by the direct-contact evaporator in conventional designs is recovered by an enlarged economizer section. The new units use a wall spraying technique of liquor firing to provide stable furnace combustion over a wide range of liquor concentrations. Liquor drying is achieved by secondary air. Air admitted to the hearth burns liquor char, reduces sulfates to sulfides, and smelts chemicals for recovery. Gases discharged from the unit can be controlled to less than 1 ppm hydrogen sulfide. Elimination of the direct-contact evaporator causes changes in the electrostatic precipitator design. The precipitator must have an increased efficiency to maintain the weight of sodium sulfate fume passing up the stack at the same level that could be achieved with conventional designs. The units will discharge more sulfur dioxide to the atmosphere, but it is expected to be below 500 ppm.

22655

Romantschuk, H. and T. Vuojolainen

RECOVER CHEMICALS FROM SODIUM-BASE SULFITE PULPING. Chem. Eng., 77(20):138-140, Sept. 21, 1970.

A commercially proven process to remove sodium and sulfur from sodium-base sulfite pulping operations is described. The process is analogous to closed chemical circulation cycles found in kraft pulp mills, with a number of exceptions. The recovered products are in the form of hydrogen sulfide (and later sulfur dioxide) and sodium carbonate. The process accepts all spent liquors, regardless of their proportions. Operations and control of the process are simple. Capital costs of the system are comparable with other plants, and operating costs are low compared with the value of the recovered products. The plant recovers 20 tons/day of SO2 and 22 tons/day of pure sodium carbonate.

22809

Shibler, B. K. and M. W. Hovey

PROCESSES FOR RECOVERING SULFUR FROM SECONDARY SOURCE MATERIALS. Bureau of Mines Information Circ., no. 8076, 62p., 1962. 561 refs.

A bibliography of articles relating to sulfur recovery methods is presented. In addition to general information on sulfur, the material on processing methods is arranged under the six principal sources of secondary sulfur, as follows: volcanic sulfur, including all elemental sulfur deposits not adaptable to the Frasch mining process; hydrogen sulfide as found in sour natural gases, petroleum refinery products, and coke-oven gases; sulfur dioxide from the roasting and smelting of metal sulfide ores and from power plant waste gases; pyrite and pyrrhotite obtained by mining mineral deposits or produced as by-products from the concentration of sulfide ore; gypsum and anhydrite occurring as deposits of calcium sulfate; and industrial wastes containing sulfates, sulfites, and sulfuric acid, such as those produced in the steel, paper, and petroleum industries. Hydrogen sulfide can be utilized for acid making and for conversion to elemental sulfur. Recovery processes for sulfur dioxide include the manganese dioxide and the ammonium sulfate methods. Sulfur from petroleum refining acid wastes can be obtained by regeneration, compounding, or coking processes. (Author summary modified)

23117

Shigeta, Yoshihiro

KRAFT PULP MILL ODORS AND THEIR COUNTERMEASURES. PART II. (Kurafuto parupukojo no akushu to sono taisaku. sono ni). Text in Japanese. Akushu no Kenkyu (J. of Odor Control), 1(2):35-42, June 20, 1970. 14 refs.

The odors from kraft pulp mills originate in the cooking, evaporation, and recovery processes which are all more or less related to the use of chemical solvents and agents. Odors produced through chip cooking depend on the types of woods, cooking temperature and time, and on the concentrations of sulfur compounds. The control of steam containing gas emission from the digester and the blow tank is the first effective countermeasure. In a batch type unit, odor emission can be reduced when steam thus lowering the blow gas and the waste gas temperatures down to exchanger thus lowering the blow gas and the waste gas temperatures down too below 60 C. Another feasible means of removing odor in a cooking process is the chlorine water contact and combustion method where the waste gas temperature is lowered to about 50 C by washing then preheated to between 80 C and 90 C for drying and finally burnt at 700 C for 0.8 second in a heavy oil burner. Oxidization of kraft black liquor is recommended for the removal of odor in the evaporation process. Kraft black liquor collected in solvent recovery boilers can be changed by pyrolysis into sulfur compounds most of which are combustible. It is noted that these odor removal techniques have to be applied very carefully in terms of boiler operation less excessive loads in a recovery boiler should result in the increase in H2S generation.

23538

Nolan, William J.

PREPULPING CHIP EXTRACTION TO REDUCE AIR POLLUTION. FINAL REPORT AND RECOMMENDED FUTURE RESEARCH. Florida Univ., Gainesville, Engineering and Industrial Experiment Station, PHS Grants AP 00612-01 and AP 00612-02, 18p., Jan. 17, 1970.

Results are summarized and future work recommended from a study to determine whether rosin removal from chips before kraft pulping would permit efficient oxidation of dilute black liquors, and to explore the pulping of rosin-extracted chips by the neutral sulfite process. Prepulping rosin extraction had no benefits in black liquor oxidation. The following conclusions were drawn from this and other phases of the investigation. (1) Pulping of the southern pines with sodium sulfite solutions instead of conventional kraft solutions of sodium hydroxide and sulfide will prevent the formation of mercaptan, hydrogen sulfide, dimethyl sulfide, and disulfide, thus eliminating the air pollution problem characteristic of kraft pulping. (2) Sodium sulfite pulping (pH range 8.5-7.8) will produce pulps with improved yield in the range of 62-68%, with strong burst, tensile, and tear characteristics. (3) Small additions of sodium carbonate to the sodium sulfite liquors may benefit pulp strength. (4) Two-stage pulping with fibration between stages will improve pulp quality with probable lower equipment costs. (5)

Three-stage screw press washers will reduce stream pollution to less than a fourth of that caused by conventional 3-stage vacuum washers. (6) Conventional kraft recovery equipment can be used to recover sodium sulfite waste liquors, replacing the recausticizing unit used in kraft recovery by three gas absorption towers. (Author summary modified)

23611

Fukui, Saburo, Masao Ono, Tooru Yoshii, Hiroshi Matsuura, and Hitoshi Sotobayashi

CHEMICAL RECOVERY PROCESS FOR HIGH SULFIDITY SPENT COOKING LIQUOR. (Koryukado jokaiyakuhin kaishuho). Text in Japanese. Kami-pa Gikyoshi (J. Japan. Tech. Assoc. Pulp Paper Ind.), 24(10):515-522, Oct. 1970. 7 refs.

A new chemical recovery process for highly sulfurized spent liquor was developed for paper manufacturing whereby highly sulfurized smelt can be obtained by absorbing the sulfur dioxide in flue gas in a solution of sodium carbonate separated from smelt solution, and by burning the resulting sodium sulfite solution together with the spent liquor. The degree of sulfurization of smelt can be easily controlled by suitably adjusting the amount of sodium carbonate recycled to the recovery system and the amount of sulfur dioxide gas absorbed in the sodium carbonate solution. This new process enables cross recovery with sulfite recovery processes such as SP and SCP with a single recovery facility; since the spent liquor of both pulps can be recovered easily, the process is technically and economically advantageous. The recovery process can be divided into spent liquor mixing-concentrating, spent liquor burning, crystallization, sulfur dioxide oxidation, and caustization, each of which is explained in detail by means of graphs and tables.

23725

White, Harry J. and Walter A. Baxter, Jr.

A SUPERIOR COLLECTING PLATE FOR ELECTROSTATIC PRECIPITATORS. Preprint, American Society of Mechanical Engineers, New York, 7p., 1959. 2 refs. (Presented at the American Society of Mechanical Engineers, Annual Meeting, Atlantic City, N. J., Nov. 29-Dec. 4, 1959, Paper 59-A-279.)

The basic importance of collecting-electrode design to over-all precipitator performance is analyzed, and a scientific program leading to the development of greatly improved collecting plates broadly applicable to a wide range of practical applications is described. A newly-designed solid collecting plate with triangular baffles was evaluated for fundamental and practical performance criteria, including electrical characteristics, aerodynamic properties, precipitation rate, rapping requirements, weight, and cost. The solid plate was superior in every measured characteristic to an expanded-metal plate tested under the same conditions. The new plate has been successfully applied to fly ash cement, powered catalyst, gypsum and alumina dust, paper-mill, oxygen converter, and open-hearth fume, and other recovery problems (Author abstract modified)

23901

Morgan, John P.

ODOR CONTROL IN KRAFT PULP MILLS. Chem 26, 6(9):30-34, Sept. 1970.

Bivalent sulfur compounds in various gaseous effluents are the main source of odor from Kraft pulp mills. Systems for reducing odors from digester and multiple evaporator areas, from black liquor oxidation, and from contaminated condensate are detailed. The system for the non-condensables from the digester and evaporator areas is based on a special burning system operated on the simple principle of an inverted chamber inside a contaminant tank partially filled with water to provide a gas seal. Gases from the evaporators are scrubbed with a recycled caustic. A strong black liquor oxidation system prevents hydrogen sulfide stripping and reduces lime reburning requirements. Treatment of the contaminated condensate is effectly handled by air stripping alone or in combination with thermal oxidation processes.

24079

Gommi, J. V.

DESIGN AND OPERATION OF ACE SYSTEM FOR KRAFT ODOR REDUCTION. Paper Trade J., 154(27):44-46, July 6, 1970. 8 refs. (Presented at the American Institute of Chemical Engineers National Meeting, 67th, Atlanta, Ga., Feb. 15-18, 1970.)

The air contact evaporator (ACE) system eliminates the kraft recovery furnace contribution to total reduced sulfur emission by eliminating gas contact with black liquor. In this system, hot gases leaving the economizer are cooled in a regenerative Ljungstrom-type heat exchanger whose heat absorbing surface is composed of closely-spaced elements. The heat is given up by the rotation of the surface into the incoming air stream. The resulting air is sufficiently hot to be used in a cascade evaporator to concentrate black liquor to 68% dry solids. It is then routed to the furnace for use as combustion air. With the system, there is no carbon dioxide present to contact the black liquor. In addition, no volatiles or products of hydrolysis can escape to the stack; whatever small amounts might theoretically be present are swept into the furnace and oxidized to SO2. Pilot development of the system and the first commercially installed unit are discussed. The latter gives lower levels of odorous reduced sulfur with unozidized liquor than required by any existing state code.

24478

MacDonald, G. L. Wayne

BCFP MONITOR CUTS RECOVERY BOILER STACK LOSSES 50%. Pulp Paper, vol. 46:39-41, April 25, 1966. 2 refs.

Removal of fume from the recovery stack gases of the kraft pulp industry can be very profitable in that the chemicals recovered, mostly sodium compounds, are a direct saving of makeup chemicals. To determine the chemical losses with recovery flue gases which have passed through electrostatic precipitators or other dust removal devices, a new instrument that measures the conductivity of a water solution of absorbed fume is described. The basis for this instrument is a mixing of a constant flow of fume containing flue gas with a constant flow of water and measuring the variation in conductivity of the resulting solution. Since sodium compounds constitute the bulk of the dust, the conductivity should vary with the sodium ion concentration. To provide a non plugging sample line through which the flue gas is drawn, a twin tubed sample probe is utilized. The second tube provides a water supply to a point before the bends of the first tube and thus washes away the dust buildup. A cooler had to be put in the overflow line before the conductivity cell to ensure a constant temperature. Sodium losses are simply the flue gas flow times its concentration.

24750

Rogers, Charles Ellis, Robert Ewing Matty, and Edward Lynn Ralston

INSTALLATION FOR THE ABSORPTION OF SULFUR DIOXIDE. (Einrichtung zur Absorption von Schwefeldioxyd). Text in German. (Babcock and Wilcox Co., New York) West Ger. Pat. 1,241,250. 9p., March 24, 1967. (Appl. June 30, 1959, 1 claim).

Equipment for the absorption of sulfur dioxide from combustion gases of Magnesium containing waste water from cellulose plants, especially from the bisulfite process, is described. It is designed to eliminate the drawback of the currently used method where SO2 saturation of the absorption liquid limits the absorption capacity by precipitating MgSO3 from the solution and thus terminates the absorption of SO2 by MgSO3 in the solution which yields magnesium bisulfite. The installation absorbs SO2 in an aqueous suspension of MgO with a pH of 4-7 by means of two consecutively connected venturi scrubbers with the suspension entering through spray nozzles. This arrangement operates with much higher levels of dissolved MgSO3 in the absorption liquid than the conventional method thereby minimizing the danger of precipitation. The cause for this increased solubility under conditions of this arrangement is thought to be the constant agitation of the liquid from the moment of monosulfite formation up to the moment of contact with the SO2 containing gas. At a liquid temperature of 49 C, a monosulfite concentration of 0.9% can be reached, expressed as SO2, at which concentration a 72% absorption of SO2 from the gas can be achieved. The absorbent liquid consisting of Mg(HSO3)2 and MgSO3 is sprayed into the scrubbers parallel with the gas flow. The liquid is separated from the gas by centrifugal force in a separator. The washing liquid leaving the installation is returned to the cellulose manufacture.

25047

Walker, A. B. and R. F. Brown

STATISTICS ON UTILIZATION, PERFORMANCE AND ECONOMICS OF ELECTROSTATIC PRECIPITATORS FOR CONTROL OF PARTICULATE AIR POLLUTION. Preprint, International Union of Air Pollution Prevention Associations, 28p., 1970. 8 refs. (Presented at the International Clean Air Congress 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-22C.)

Selection of an optimum control strategy requires accurate cost-benefit information specific to individual sources. As part of an overall system study on particulate emission control with electrostatic precipitators, and exhaustive compilation of performance and economic data on precipitators for specific applications is presented. Eight application areas are covered, including: electric utility industry; pulp and paper industry; iron and steel industry; rock products industry; chemical process industry; mining and metallurgical industry; petroleum industry; and miscellaneous. Performance, capital cost, operating cost, annualized cost according to age of installation, and cost factors as related to process output are presented. Information presented should prove useful to those examining alternative strategies for control of particulate emissions using either simulation model or maximum use of state-of-the-art approaches. (Author abstract modified)

25085

Lindberg, Erik Axel Sigvard

METHOD OF GETTING RID OF MALODOROUS AIR AND WATER POLLUTANTS FROM ALKALINE PULP COOKING. (Uddeholms A B, Uddeholm (Sweden) U. S. Pat. 3,520,772. 3p., July 14, 1970. 2 refs. (Appl. April 25, 1966, 1 claim).

In an alkaline pulping process, especially the manufacture of so-called 'sulfate pulp,' the noxious and malodorous gases and vapors leaving the digesters in the cooking of the wood chips, without passing through a condenser, are brought, together with steam from the digesters directly to a furnace, where the gases are burned or rendered innocuous by thermal decomposition. In the process described, the pollutant gases leave the digester together with steam and are passed directly to a furnace without passing through a condenser. The furnace where the combustion takes place is preferably associated with a conventional boiler, such as a soda recovery boiler, or a continuous lime kiln. The gases flow from the digester to the furnace without condensation of noxious constituents which when condensed would only be a different kind of nuisance; but they may pass through a superheater in order to prevent such condensation during such passage. Thus, not only is the atmosphere in the vicinity of the pulp mill protected from pollution by the discharge of noxious gases, but the streams and lakes and low places which might be used as settling ponds are also protected against pollution. The waste gases consisting of the pollutants mixed with steam from the cooking process and oxygen for the burning are proportioned so that the oxygen concentration is below that of an explosive mixture, so that the combustion is safe. The heat content of the gases can be recovered by use of a flue gas scrubber. Previous methods involve cooling the gases in a condenser, or destroying the noncondensible gases b combustion. The effluents of these operations either leave the plant in the form of water pollution, or require further expensive processing to be eliminated. The method described avoids these unnecessary problems. (Author abstract modified)

25171

PULPERS PROBE ANTI-POLLUTION MEASURES. Can. Chem. Process., 54(6):63-64, 66-68, June 1970.

Several chemical recovery systems are being examined by Canadian sulfite and kraft pulpers as possible low-cost routes to pollution-free mills. The systems include the use of ammonia as a pulping chemical with re-absorption of sulfur dioxide in fresh ammonia solution for re-use as cooking liquor, a rotary kiln process for producing salt cake for kraft pulping or sodium carbonate for a sulfite mill, an ion exchange process for extracting chemicals from waste liquor, a method of making up sulfite or bisulfite liquor with an organic carbonyl compound to produce a sulfonic salt capable of exchanging with an alkali metal salt of an inorganic acid, and chlorine-dioxide generation with effluent evaporation and sodium sulfate crystallization. Also unde investigation are monopolar cells with titanium anodes for monitoring mercury pollution and the effects of gamma irradiation on gas emissions from kraft pulping and on waste liquor from sulfite mills. Summing up, there is new technology waiting to be proven more economical than previous techniques. The main question is whether the pulpers and public authorities can mutually establis a feasible timetable for control measures.

25190

Hendrickson, E. R., W. Gene Tucker, and J. S. Roberson

ADVANCES IN AIR QUALITY IMPROVEMENT IN THE WOOD PULPING INDUSTRY. Preprint, International Union of Air Pollution Prevention Associations, 17p., 1970. 2 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-16D.)

To comply with the direction of Congress in the Air Quality Act of 1967, the National Air Pollution Control Administration contracted for a systems analysis study to make a comprehensive and systematic evaluation of the technical and economic problems involved in the control of airborne emissions from the wood pulping industry. One of the major objectives of the study was to determine the technological gaps that needed to be filled by accelerated research and development in order to attain reasonable air quality in the vicinity of these operations. Inlcuded in the scope of the work were major variations of the kraft, sulfite, and semichemical pulping processes; the nature and sources of emissions from each process; a review of control hardware capabilities, efficienncies, and costs; a review of source and ambient air sampling and analysis techniques; and an evaluation of the overall economic impacts of air quality improvement in the industry. Major gaps in technology have been identified; needed areas of research of highest priority are as follows: develop and standardize methods and instruments for monitoring emissions and ambient air; assess the effect of operating variables on emissions from the kraft pulping and recovery systems; develop and standardize organoleptic techniques for determinations of process emissions and evaluation of ambient air quality; investigate new pulping methods which eliminate the use of sulfur; define the mechanisms, with emphasis on transport processes and emission interactions, which will relate emission limitations to ambient air objectives; evaluate emissions from sources in sulfite and neutral sulfite semichemical mills and determine operating variables which affect emissions; investigate adsorption and absorption of odorous gases and reuse of the collected material in process; and determine whether total recoverable sulfur is an effective measure of the acceptability of odorous emissions from kraft mills or must the compounds be identified more definitively. (Author abstract)

25211

Adams, F. A., S. F. Galeano, R. J. Gilmer, and R. B. Valley

ADVANCES IN AIR POLLUTION CONTROL IN NEUTRAL SULFITE SEMI-CHEMICAL MILLS. Preprint, International Union of Air Pollution Prevention Associations, 31p., 1970. 16 refs. (Presented at the Internationa Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-16C.)

Approximately 80% of the pulp production in the U. S. A. originates from processes using chemicals; 75% of the total uses sulfur compounds as one of the active cooking ingredients. Sulfite semi-chemical processes are gaining in popularity since the last decade. The permanence of sulfur as a cooking agent is discussed in light of recent pulping capital investments, availability of the chemical sulfur, and success in reducing sulfur compound emissions. Different process modifications introduced at two company mills, at Big Island, Virginia, and Tomahawk, Wisconsin, where pulping of hardwoods is performed at rates of 550 and 630 tons per day, respectively, are discussed. These two mills were the first ones of their kind to practice chemical recovery, with subsequent improvement of the water pollution problems in the receiving streams. The reduction of gaseous sulfur emissions followed a preconceived plan generally outlined in 1967. The cascade evaporator was eliminated in 1968, as a concentrator of spent liquors in the Tomahawk operation. This practice, now gaining popularity in the U. S. A., was originated in Northern Europe several years ago. The methodology and concepts used to minimize total reduced sulfur, total sulfur oxide emissions, carbon monoxide, and nitrogen oxides emissions from the recovery furnace of the Tomahawk operation are explained. Thermodynamics of the combustion process and proper turbulence were instrumental to achieve reduction of sulfur compound emissions from this unit. The reduction obtained in this fashion represents around 10 pounds of sulfur per ton of pulp produced. Another major improvement in the conventional chemical recovery system has been implemented already in the Big Island mill. Conventional hydrogen sulfide emissions from the sulfiting tower, on the order of 8 to 10 pounds as sulfur per ton of pulp, have been completely eliminated by a process modification technique. A similar approach will permit the use of the recovered sulfur from power boiler flue gas emissions rich in sulfur dioxide. This is a frequent case in mills which depend on high sulfur coal for the generation of steam and electricity. Other improvements in the recovery system are indicated which help limit sulfur gaseous emissions to levels of present and foreseeable quality criteria. (Author abstract modified)

25493

Schmied, Jozef, Jan Polcin, and Justina Kapustova

THE UTILIZATION OF HIGH PRESSURE WASTE GAS ENERGY FOR THE INTENSIFICATION OF SULFUR DIOXIDE CONVERSION. (Spusob vyuzitia energie vysokotlakovych odplynov na intenzifikaciu absorpcneho prevodu SO2). Text in Slovak. (Czechoslovak Republic) Czech. Pat. 106,754, 3p., March 15, 1963. (Appl. Feb. 20, 1961, 2 claims).

The invention utilizes the high pressure energy of waste gases from the sulfite cellulose manufacture to intensify SO2 absorption and to raise the effectiveness of SO2 regeneration by using the pressure gradient between the boiler and the absorber to disperse the waste gas into the absorbent liquid by means of gas jets. In this manner the velocity and consequently the kinetic energy of the waste gas increases which leads to the formation of smaller bubbles, to an increase of the surface of the gaseous phase, to increased turbulence of the liquid phase, and a resulting intensification of the conversion of SO2 from the gaseous to the liquid phase. The desired choking of the gas is accomplished by the choice of an appropriate bore and number of jets. Since the volume of waste gas fluctuates in the course of the boiling cycle the jet system is automatically regulated, and a constant desired pressure is maintained in the absorbers.

25643

Sykes, W. and F. Broomhead

PROBLEMS OF ELECTRICAL PRECIPITATION REVIEWED. Gas World, 134(3494):98-104, Aug. 4, 1951. 5 refs.

Aspects of the design, construction, and operation of the electrical precipitator are discussed. The great advantage of this device is its ability to remove with high efficiency dust of particle size much smaller than that removable by mechanical or cyclone separators. Back pressure, and power needs to produce the corona discharge, a very small; however initial costs are much higher. Problems considered at length include removal efficiency and its relation to time contact of the gases in the field, design of the precipitation chamber, insulator breakdown, gas distribution across the precipitator, removal of deposits from electrodes, and electrical equipment requirements. Five essential design factors are given: correct time contact, good gas distribution throughout the fields, design and arrangement of the electrodes, maintenance of clean electrodes, and maintenance of correct voltage. Examples of the following typical application are described and the principal design features are indicated in each case to point up the great variety of constructions required by specific and differing operating conditions: detarring of producer gas from coal and coke, chamber and contact process sulfuric acid manufacture, aluminum and cement production, boiler flyash precipitation, gypsum dust removal, sodium sulfate recovery in the Kraft pulp industry, cleaning of blast furnace gas, air conditioning, and spray painting.

25863

Weimer, Ervin C., Harold W. Shideler, and Stuart M. Porter

METHOD AND APPARATUS FOR RECYCLING DRYER STACK GASES. (Stearns- Roger Corp., Denver, Colo.) U. S. Pat. 3,538,614. 5p., Nov. 10, 1970. 3 refs. (Appl. Sept. 9, 1968, 6 claims).

The conventional pulp-drying installations include a gas-fired furnace, the gaseous products of combustion of which are fed into a rotating drum-type dryer containing wet pulp. The dried product emerging from the discharge end of the dryer is either recovered directly or else sucked up by an induced draft fan and fed to one or more cyclone-type recovery vessels where the dry product is draw off the bottom while the gaseous elements are discharged through th top. By returning the gases and entrained solids to the system at the proper point, the solids can be incinerated without the oxygen- lean recycled gases acting to inhibit combustion. Also, these same lean recycled gases can be combined with the gaseous products of primary combustion to produce a substantially inert mixture which will not support combustion in the dryer section or bring about detrimental oxidation of the product. By using the recycled stack gases to cool the hot, undiluted primary combustion gases, the conventional practice of using secondary air from the atmosphere as a coolant is eliminated. All components of the recycling system must be maintained at a temperature somewhat higher than the dew point of these recycled gases, or the condensible fractions will condense out on the cold surfaces and entrap the entrained solids s as to eventually clog the ductwork. While the amount of heat recovered by burning the entrained solids is not great, it, together with the heat saved by using the already warm stack gas as secondary air instead of air from the atmosphere, combine to bring about an overall fuel saving of somewhere between 5 and 8%.

25950

Archibald, E. E., Jr. and A. van Donkelaar

AIR QUALITY CONTROL IN A BLEACHED KRAFT MILL. Preprint, Canadian Pulp and Paper Assoc., 14p., 1967. 10 refs. (Presented at the Paper Industry Air and Stream Improvement Conference, Third, Vancouver, B. C., Oct. 23-26, 1967, Technical Paper T346.)

The engineering equipment and practices employed at one bleached kraft pulp mill to reduce malodorous gaseous emissions are described. Black liquor oxidation combined with optimum conditions in the recovery furnace can reduce hydrogen sulfide emissions from the main stack to near zero. Noncondensibles from cooking and evaporation processes are successfully collected and subsequently destroyed with a high degree of efficiency by a system of incineration and/or chlorination. Typical emission data are tabulated. A home-monitoring system, supplemented by in-plant monitoring is providing information on changes and improvements in mill emissions.

25977

Osterli, Victor P.

AIR POLLUTION CAUSED BY AGRICULTURE AND FORESTRY: ODOR. In: Project Clean Air. California Univ., Berkeley, Task Force No. 5, Section 6, 4p., Sept. 1, 1970. 20 refs.

The development of methods to control odor at the site and for disposal of livestock and poultry fecal matter is a major need. One possible process, wet oxidation, could be of real significance since it would not only eliminate the fecal matter but would produce energy to carry out the disposal process and possibly even convert the wastes to animal feed. Treating the manure with chemical deodorants may provide a partial solution. A specific application of the pyrolysis-combustion process could be an alternative to current methods of incineration used which would eliminate or substantially alleviate the problem of malodors. Afterburner-type devices are available for some kinds of rendering plants to control odors. In addition to animal wastes and odors from meat processing and rendering plants, more than 28 million tons of wood pulp are produced yearly in the United States by the sulfate or kraft process which produces a pollution problem.

26172

Collins, T. T., Jr.

OXIDATION OF KRAFT BLACK LIQUOR – WHERE DOES IT STAND? Paper Trad J., 146(30):39-48, July 23, 1962. 153 refs.

The literature and patents on black liquor oxidation are reviewed in an attempt to clarify the sources of original discoveries. In addition, objections to foaming-type oxidation units are noted as are the advantages claimed for new systems such as the British Columbia Research Council, modified Trobeck, Tomlinson, and Weyerhauser systems. Also reported are studies on the application of oxidation systems in sulfite recovery, studies of the economics resulting from black liquor oxidation, studies showing reduced tube corrosion by oxidized liquor, catalyzed reactions of oxygen with alkaline sulfide solutions, and procedures for analyzing oxidized liquor samples. It is noted that many mills will now be forced to install oxidation systems as one step in more complete odor control programs. Mills that are not under criticism for stream or air pollution will probably continue to operate without oxidation systems. These mills will be among those not using extra sulfur above salt cake for make-up for desired sulfidity, that do not find an appreciable cost advantage in substituting soda ash for part of the salt cake, and that do not wish to oxidize liquor merely to balance the saving of fuel for reburning lime.

26173

Guest, E. T.

RECENT DEVELOPMENTS IN BLACK LIQUOR OXIDATION. Paper Trade J., 148(12):30-34, March 23, 1964. 8 refs.

It is possible to eliminate almost completely hydrogen sulfide from kraft mill stack gases with a fully oxidized black liquor, followed by a properly loaded and operated furnace. When the definite odor reduction in the evaporator condensate is also considered, it is evident that oxidation is an essential link in overall odor control. The most prevalent oxidation techniques are the Collins system, the British Columbia Research Council system, and the Troebeck-Ahlen system. Of these, the Troebeck- Ahlen and the Collins type oxidize by forcing air through the liquor in a manner to make a controlled volume of foam. The BCRC unit operates with air blowing concurrently with the liquor over specially designed plates. Other systems are packed columns with either concurrent or countercurrent air, compressed air in a tank of liquor, or compressed air in a pipeline. A detailed discussion is presented of pilot-plant work on the Troebeck-Ahlen unit together with a summary of pilot-plant results. The data have been incorporated into the design of commercially available towers.

26176

Ghisoni, Pietro

ELIMINATION OF ODORS IN A SULPHATE PULP MILL. Tappi, 37(5):201- 205, May 1954. 12 refs. (Presented at the 7th Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Houston, Tex., Nov. 18-20, 1953.)

A plant for eliminating mercaptans from an Italian sulfate pulp mill is described. The mill is located in a narrow valley, on a river with a very limited water flow, near a heavily populated area. The main operations in the odor control plant are: (1) condensation of all relief and blow gases with indirect condensers; (2) use of the condensed water as dilution water in a chlorination tower of the bleaching plant; (3) the noncondensable gases are burnt in one boiler together with natural gas; (4) the smoke from the recovery boiler is cooled to the dew point, then oxidated with chlorine and again heated to avoid corrosion in the chimney. (Author abstract modified)

26254

Perrine, Richard L. and Limin Hsueh

MISCELLANEOUS INDUSTRIAL EMISSIONS. In: Project Clean Air. California, Univ., Berkeley, Task Force 5, Vol. 1, Section 14, 5p., Sept. 1, 1970. 3 refs.

Five broad categories of industrial polluters are briefly considered, as well as their kinds of emissions and control problems. The inorganic chemical industry has problems with hydrochloric acid, hydrofluoric acid, nitric acid, sulfuric acid, calcium oxide, chlorine, soaps and detergents. Steel production is a major industry, but the open hearth furnaces are gradually being replaced by the basic oxygen furnace. Although this also produces fumes, the new plants can be constructed with proper control equipment. Foundries may change the work they do from day to day so that control problems are at their worst, but methods to trap particles and fumes are available. The handling of large volumes of minerals normally involves problems with dust, while the special biological effects of asbestos must be noted. Glass fibers can also be a problem, as well as fluoride-containing ores. Copper lead, and zinc mining and milling operations involve dust problems, while sulfur oxides may be released during smelting. Hydrogen sulfide, mercaptans, sulfide and polysulfides which have very bad odors, and other noxious gases are emitted during wood pulp processing. Typical gaseous emissions from Kraft pulping are presented tabularly. Coffee roasting plants, slaughterhouses, and pickel plants emit strong odors. An areas of concern is new processes to break down waste and return it to a state useful in natural processes without problems of storage. A particularly important point which needs to be considered is site location.

27138

Straforelli, J. B., L. Paszner, and J. W. Wilson

RADIOLYSIS OF KRAFT MILL GASEOUS EFFLUENTS. Preprint, Canadian Pulp and Paper Assoc., Technical Section, and Chemical Inst. of Canada, p. 57, 1970. (Presented at the Canadian Wood Chemistry Symposium, 3rd, Vancouver, B. C., June 24-26, 1970.)

Gas chromatographic studies of radiolytic effects of atomic radiation from a cobalt(60) source on model compounds of kraft mill gaseous effluents are briefly noted. Hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and sulfur dioxide were effectively destroyed or made practically undetectable following irradiation to at least 1 to 3 Mrad dose (at approximately 1 Mrad/hr intensity) in the presence or absence (in purified nitrogen) of oxygen (or air) and atmospheric moisture at NTP conditions. Slightly higher doses were required for gas mixtures. An hypothesis for the process mechanism is suggested. The process effectively handles concentrations that are beyond such currently used control methods as oxidation and absorption towers. (Author abstract modified)

27182

Balmer, Tom

ADJUSTABLE FLOODED-DISC MAINTAINS SCRUBBER EFFICIENCY. Design News 26(2):934-935, Jan. 18, 1971.

High energy scrubbers clean exhaust gases by capturing extremely small, low-mass particles in water droplets. To do this efficiently, the relative velocity of particles and droplets must be high enough to enable particles to penetrate the droplets and be captured. Without some means of pressure drop control, a decrease in gas flow lowers collection efficiency. Flooded-Disc Scrubbers automatically hold an optimum pressure drop, despite variations in gas flow, by adjusting the throat area of the turbulence orifice. A flat disc moves axially in a conical flue in response to exhaust gas pressure changes. Raising or lowering the disc adjusts pressure drop across the scrubber, which in turn controls particle collection efficiency. Danger of nozzle plugging and other water flow restrictions are eliminated by the self-purging system. Applications to date include electric arc and basic oxygen furnaces, as well as kiln and processing plants for mineral products, pulp, paper, and fertilizer production.

27288

Shigeta, Yoshihiro

TECHNIQUE CONCERNING THE PROCESS TO REMOVE OFFENSIVE SMELL BY COMBUSTION. (Nensho hoshiki ni yoru akushu jokyo gijutsu). Text in Japanese. PPM (Japan), 2(1):54-59, Jan. 1971. 7 refs.

Difficulties in odor countermeasures are caused by the following factors: first, impulse measurement of the sense of smell varies logarithmically with the concentration of the substance of the offensive odor. Thus, slight increase in the offensive substance is not easily sensed. The second factor is based upon the law of Weber-Fechner. A 50% removal rate of the offensive odor is scarcely perceived by the sense of smell while when a removal rate of between 99.9% and 99.99% is obtained, the decrease in offensive odor is admitted by the neighboring citizens. Third, sense of smell fatigue may become an obstacle when the concentration of offensive odor is measured or a test of the sense of smell is conducted. Fourth, the offensive odor that causes complaints of the neighboring citizens comprises multiple contents of which each has its own threshold value. Fifth, there is a great difference in each individual's sensory organ. Sixth, the evaluation of offensive odor pollution varies with areas. In connection with a combustion deodorization process, at first an odor has to go through the minimum condition of heating to 650 C for more than 3 seconds. It is not permissible for an offensive odor to go through imperfect combustion in stoking equipment. Setting two sheets of steel in stoking equipment helps to avoid such a possibility. In case oversaturated moisture and offensive odors are mixed with each other at such a high temperature in a digester used in a kraft pulp factory or in a dryer, glossal stoking equipment and an energy source are necessary to remove the offensive odor by burning. Therefore, moisture in the offensive odor has to be removed in advance before the combustion deodorization process is operated. The following process is most often adopted as effective for removing moisture: dust mixed with the offensive odor is at first removed by a cyclone. Then vapor in the offensive odor is removed because the temperature of the offensive smell is reduced until it is about 15 degrees higher than that of air. The residual vapor is eliminated by an ejecter while the residual moisture is again eliminated by an after- condenser.

27357

Wright, R. H. and R. W. Klinck

WHAT PORT ALBERNI HAVE DONE TO CONTROL KRAFT MILL ODORS. Paper Trade J., 139(41):22-24, Oct. 10, 1955. 11 refs.

A kraft pulp mill has reduced recovery system odors with a well- designed black liquor oxidation system employing a very large ratio of air to black liquor and with a simple provision for adding digester gases to the air supply. The system uses twin oxidation towers in which the black liquor flows downward through asbestos- cement plates. The two towers are located immediately adjacent to the hot-water accumulator tank which is part of the blow-heat recovery system, and the forced air fan which supplies air to the towers draws its air through a duct connected to the accumulator tank vent pipe. When the towers are operating, their air supply is first drawn downard through the accumulator vent; when the towers are not operating, the vent pipe continues to fulfill its original purpose. In this way, noncondensible digester gases are easily mixed with the air supplied to the towers, or, alternatively discharged to the atmosphere. With the towers, the mean rate of emission during a digester blow is now 0.36 rather than 2.24 gr/sec Although the rate is still sufficient to produce a noticeable odor for a short distance downwind, both the intensity of the odor and its range are much less than they would be in the absence of the oxidation system.

27470

FLUIDIZED BEDS--PART I: FLUIDIZED REACTORS BECOMING POPULAR. Can. Chem. Process., 55(2):20, 21, 24, Feb. 1971.

Canada's pulp and paper and metallurgical industries are increasingly turning to fluidized-bed reactor systems since these offer thermal efficiency and uniformity of reactor environment. Basically, a fluidized bed functions when a bed of solid particles is set in fluid motion by directing a stream of gas, under carefully controlled conditions, up through the bed. The gas stream forces a passage between the particles, setting them in homogeneous motion and causing the solids to take on a fluid character. Advantages resulting from this fluidized state are temperature control, continuity of operation, hea transfer, and catalysis. A new application of the fluidized-bed reactor is the reduction of zinc concentrates to calcine. One plant has solved the problem of removing the calcine dust from sulfur dioxide-containing roaster gases by a combination cyclone-electrostatic precipitator system. The roaster plant is provided with control instrumentation for sulfur dioxide analysis and precipitator electrical data. An important feature of the fluidized bed reactor in iron ore reduction is the reduced gas throughput and resulting higher SO2 concentrations in the gas which permit more efficient acid production. The heat of reaction in this type of reactor is commonly scavenged to provide process steam.

27762

Calvert, Seymour

AIR POLLUTION RESEARCH PROBLEMS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 36p., 1970. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo. June 14-18, 1970, Paper 70-24.)

A survey was conducted to determine the areas for air pollution research, and research topics are listed. Suggestions for the definition of sources such as power plants, metallurgical processes automobiles and transportation, rock processing, incineration and pulp and paper, and alternatives for an optimum solution are given. Topics for the development of better sampling and analytical method include gases, particles, odor, stack monitoring and visual. Other problem areas are in the field of control technology for gases, the use of filters, wet scrubbers, centrifuges and electrostatic precipitators for particulates, and control in such specific sources as fuel burning power plants, pulp and paper, metallurgical processing, automobile and transportation, rock processing, and incineration. There is also a need for more reliable and accurate cost data on air pollution control processes and equipment. Dispersion, tall stacks, modeling, and visibility are also discussed. Problem areas on the effects of air pollution on human health, animals and plants, and materials are described. The need for information on air quality criteria, air quality standards, emission standards and economics, sociology, and politics are also brought out.

27901

Balakrishnan, S. and R. N. Rickles

BY-PRODUCT RECOVERY AND AIR POLLUTION CONTROL. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 19p., 1970. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-111.)

Practical applications of the concept of by-product recovery from air streams were studied. Valuable by-products may include a major product that is collectable in a commercial form such as iron ore dust from blast furnace gas effluents; a major product collectable in a non-commercial form such as dilute solution; and a saleable or presently usable by-product such as the recovery of chemicals from Kraft spent liquor. General methods for treating gaseous wastes include adsorption, absorption, ion exchange, membrane permeation, and chemical reaction. By- product recovery is described for paper and pulp mills, petrochemical industries, the fertilizer industry, the organic chemicals industry, and the inorganic chemical industry. Production of chlorine from hydrochloric acid and product recovery from flue gas treatment are also described. The choice of a method of treatment depends on the economic considerations and degree of treatment desired. Removal of pollutants to the desired level is generally achieved through conventional processes, but it should be realized that the same degree of treatment can be achieved either by product recovery alone or by a combination of product recovery and conventional treatment processes. The advantage of reducing pollutional load through product recovery consists in the overall reduction of the cost of treatment and conservation of natural resources.

28328

Umezawa, M. and Osamu Shimura

TREATMENT OF SULFUR DIOXIDE IN STACK GAS. (Shisshiki haien datsuryusochi no tekiyoshiken). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):189, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 10th, 1970.)

Experiments were conducted to determine whether wet desulfurization methods are applicable to the paper manufacturing plants to be constructed in the Fuji area. There will be about 200 plants using about 2700 kl/day heavy oil. The two desulfurization methods tested were the Shinko-type gas absorption and the multipore-plate waste-gas desulfurization systems. The items tested were sulfur dioxide concentration at the entrance and exit of the systems, rate of desulfurization, volume of gas treatment, gas temperature at entrance and exit, volume of treatment water, carbon dioxide and oxygen concentration at the exit, and pressure loss. The experiments were conducted on the assumption that alkaline water-water could be used for treatment, but water of general alkaline quality could not be obtained. Also, there was some corrosion of equipment.

28580

Billings, Charles E. and John E. Wilder

ENGINEERING ANALYSIS OF THE FIELD PERFORMANCE OF FABRIC FILTER SYSTEMS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa. 41p., 1970. 15 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-129.)

Results of a survey of a number of operating fabric filter systems are presented for industrial categories which include combustion, food and feed, pulp and paper, inorganic chemicals, organic chemicals, petrol refining, non-metallic minerals, iron and steel and non-ferrous metallurgy. Data are presented on major engineering variables affecting design and use (filtering velocity, dust concentration, and specific dust-fabric filter resistance coefficient), on economic factors related to capital, operating and maintenance costs, and on types of operating problems or failure modes associated with bag life, repair, and maintenance. Sizes surveyed ranged from 100 to 100,000 sq ft. Specific dust-fabric filter resistance coefficients ranged from 1 to 1000, depending upon parameters such as particle size, application, and fabric construction. Capital costs ranged from 1 to greater than $20/cfm, depending principally on severity of service requirements. Maintenance costs ranged from $0.10 to $1.0/cfm/yr. Reported bag life ranged from a few months to greater than 10 years. Generally, most applications surveyed indicated one or more of several bag failure modes or other problem areas associated with continued satisfactory performance. (Author abstract modified)

28656

Gavrilescu, GH.

CONDITIONS FOR OBTAINING SO2 GASES IN AN OVEN WITH A FLUIDIZED-BED, FOR USE IN THE MANUFACTURE OF 'RED STAR' CELLULOSE AND PAPER. (Consideratii asupra obtinerii gazelor de SO2 in cuptoare cu pat fluidizat la fabrica de celuloza si hirtie 'steaua rosie'). Text in Rumanian. Celul. Hirtie (Bucharest), 12(1):14-22, 1963. 4 refs.

Sulfur dioxide is used in the papermaking industry to prepare the bisulfite solution used for cooking the wood pulp. A set of 10 conditions are given, by which maximum efficiency and quality will be achieved in the production of SO2 gas in a pyrite-roasting oven. These include proper purification of the gaseous product, a suitable concentration (at least 12%), a suitable temperature (20 C), the recovery of byproducts (sulfuric acid, heat in the form of hot water or steam, pyrite ash for metallurgical use, arsenic and selenium salts), and protection of the working environment against SO2 and other poisonous fumes. The 'Red Star' factory is equipped with four Kuhn-type mechanical ovens, each with a burning surface of 80 sq m. Each oven is in turn equipped with a cyclone o 1100 mm diameter. The cyclone design and the high content of ash in the gas (2200-2800 mg per cu m) are factors that greatly reduce the efficiency of particulate removal. Various suggestions are made for bringing actual standards of production, efficiency, and safety closer to the ideals enumerated.

28792

CANADA'S COPELAND SYSTEM MAKES INROADS INTO HOME MARKET. Water Pollution Control (Toonto), 109(3):14-15, 1971.

The Copeland system is a fluid bed process for incinerating any solid or liquid waste containing heat energy. The process uses a bed of solid particles that are kept in a state of agitation and partial suspension by a stream of gas (or air) forced into the bed through orifices. This causes chemical reaction or combustion to take place at the desired temperature. The system employs scrubbing and absorption stages for removal of all particulate matter and undesirable oxidized gases. Heat values are recoverable as steam from the gases in a waste heat boiler, or as hot water in a scrubbing stage. In addition, valuable inorganic chemicals are reclaimed. Applications of the process include pulp mills, oil refineries, oil shale, distilleries, chemical plants, and sewage sludge.

29085

Coulter, T. R. and R. L. Reveley

PRECIPITATOR-SCRUBBER COMBINATIONS FOR RECOVERY BOILERS: A CASE HISTORY. TAPPI, 54(4):530-532, April 1971. 4 refs. (Presented at the Water and Air Conference of the Pulp and Paper Industry, Minneapolis, Minn., June 7-10, 1970.)

Design criteria and data are presented for two spray scrubbers intended to reduce particulate emissions from two kraft mill recovery boilers. The first unit follows an existing 500-ton recovery boiler electrostatic precipitator of 95% efficiency; it should raise overall collection efficiency to 98.5%. The second scrubber follows a very high efficiency electrostatic precipitator for a new 850-ton boiler. This scrubber was selected to eliminate any possibility of 'snowing' or carryover from the precipitator. Made of fiber glass reinforced polyester, the scrubbers act as cyclones, causing the entrained particulate matter to move toward the walls of the tank where it is wetted by the sprays and runs to the bottom to be drawn off. 'Core busters' located above the sprays prevent droplet carryover. Weak wash is the tentative scrubbing medium for the first scrubber, and fresh water the tentative choice for the second scrubber. Effluents from the bleach plant caustic stages will also be tried. Operational data on the scrubbers will be presented in a later report.

29231

Nakai, Yoshiyuki and Tetsuya Yokokawa

ACTUAL EXAMPLES OF KANAGAWA RESEARCH INDUSTRIAL INSTITUTE TYPE DESULFURIZING UNIT FOR WASTE GAS. (Shin ko shi shiki haien daturyu sochi no gutaiteki jitshi rei). Text in Japanese. Kagaku Kogaku (Chem. Eng.), 35(1):36-42, Jan. 1971.

Practical Kanagawa Research Institute type desulfurizing units for waste gas classify roughly into nonrecovering and recovering gas absorbing units. The nonrecovering type uses fresh or sea water as the absorbing solution for sulfur dioxide. The absorbing solution is released in a harmless condition without recovering the SO2. The recovering type effectively uses absorbed SO2 without causing a public nuisance. The gas and absorbent contact, but the liquid s surface tension causes them to form a thin surface on the wire mesh. Gas sucked into the unit cannot pass through without contacting the liquid plane. Also, the gas-liquid rate can be arbitrarily decided. If a greater rate of gas to liquid is needed, the quantity of flowing liquid is increased. Pressure loss at the contact surface is not related to the change of the liquid-gas rate. An actual example is the use of desulfurizing with hydrogen in the final gas treating unit in petroleum refining. When hydrogen sulfide produced by hydrogen desulfurization enters the combustion furnace for waste gas and becomes sulfurous anhydride, the desulfurizing unit is needed for high concentrations. Another application is the treating unit for waste gas from sintering furnaces in iron foundries. This gas is of fairly high concentration. Further, the gas includes many powder dusts but the KRI-wet-type has a good ability to manage for the structure without kinetic parts. Also, the waste gas treatment unit from the boiler in paper mills makes a caustic soda solution absorb sulfurous anhydride in waste gas. The produced sodium sulfate is used as a medicine for a pulp steam bath.

29278

Alferova, L. A. and G. A. Titova

OXIDATION OF SODIUM SULFIDE AND MERCAPTIDE IN BLACK LIQUOR. Bumazhn. Prom. (Moscow), 41(10):5-6, Oct. 1966. Translated from Russian by Brenda Jacobsen, Washington Univ., Seattle, Dept. of Civil Engineering, 11p., Oct. 31, 1970.

To determine optimum conditions for black liquor oxidation, aqueous solutions of hydrogen sulfide, methyl mercaptan, and their salts were oxidized by aeration at various flow rates and temperatures and within a wide range of pH. For all solutions, the rate of oxidation was determined mainly by temperature and area of contact between the solution and oxidizing agent. Both hydroxone and hydroxyl ions had a catalytic action on the rate and mechanism of oxidation. To achieve a large contact area, aeration should be carried out in an atomizing-type apparatus. Temperature should be 80 to 100 C and pressure 4 to 5 kg/sq cm. Under these conditions, the rate of oxidation is determined by the value of the pH and of the ionic salt of the black liquor. The final pH must not be lower than 12.5, as at a lower pH other oxidation products (thiosulfates, sulfites, polythionates, etc.) predominate. The oxygen consumption under optimum conditions is approximately equal to theoretical calculations. (Author abstract modified)

29621

Galeano, S. F., D. C. Kahn, and R. A. Mack

AIR POLLUTION: CONTROLLED OPERATION OF A NSSC RECOVERY FURNACE. TAPPI, 54(5):741-744, May 1971. 10 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Engineering Conference, Denver, Colo., Oct. 25-29, 1970.)

Gaseous sulfur emissions from a kraft recovery furnace used in a neutral sulfite semichemical (NSSC) recovery system can be minimized by changes in operating variables. It is possible to obtain close to zero emission of total reduced sulfur by using proper distribution and quantities of primary and secondary airflows. Thermodynamics of the combustion and a scale of turbulence permit estimating those quantities. The sodium-to- sulfur weight ratio of the liquor fed to the furnace (in the 2-3 units range), is inversely proportional to the amount of sulfur dioxide, released from the furnace. Adequate recording instrumentation in the process streams is essential in achieving the desired results. New recovery furnaces for NSSC processes can be expected to achieve the same degree of pollution control as new ones used in the kraft process. (Author abstract)

29628

LAW-MAKERS SAY: CLEAN UP OR SHUT DOWN. Can. Chem. Process., 55(4):47-50, April 1971.

The major push by the Canadian government to control air pollution will surely come once Parliament approves Bill C-224, the Clean Air Act. Under the Act, air polluters may be fined up to $200,000 per instance of violating one or more of the emission standards to be set by the Federal government. Also, the Act will empower federal authorities to fine any pollution source regardless of location; this is a major departure from current federal/provincial division of powers. Controlling the fumes from coking is mentioned, as well as regulations pertaining to the emissions from petroleum refineries, lead-in gasoline, automotive emissions, and aircraft exhaust smoke. Processes for the removal of sulfur dioxide are listed tabularly. The British Columbia government has offered a prize of $250,000 for the first individual or company to come up with a device to eliminate air pollution and odor of pulpmills.

29650

Zimmerman, Mark D.

POLLUTION TECHNOLOGY--WHAT THEY RE DOING OVERSEAS. Machine Design, 42(29):20-21, 23-25, 27, 30, Nov. 1970.

Solutions to pollution problems from overseas are discussed. The world s first operational plant for completely recycling waste water was built in Windhoek, Southwest Africa. A sulfate digester is being built by Karlstads Mekaniska Werkstad, Stockholm, for a Billerud pulp mill near Gruvon, Sweden. Sludge-aeration systems have been built. Toilets are being redesigned to save water and be sprayed clean. A German pollution control firm offers a wide variety of electrostatic precipitators, venturi scrubbers, centrifugal collectors, catalytic reactors, filters, and cyclones for cleaning waste air or gases. Methods of refuse disposal are cited. British researchers tat the University of Aston are experimenting with additives that make plastics decompose when exposed directly to the ultraviolet rays of sunlight for about two months. Methods of handling oil slicks are being developed, and alternatives to power generation are being sought.

29852

Rautu, R.

ALKALI AND HEAT RECOVERY IN THE FLUE GASES FROM RECOVERY BOILERS. (Posibilitatea recuperarii alcalilor si a caldurii din gasele reziduale de la cazanele de regenerare). Text in Rumanian. Celul. Hirtie (Bucharest), 19(10):368-373, Oct. 1970. 8 refs.

The situation in sulfate pulp mills which do not use flue gas scrubbing is presented. Modern systems of alkali recovery in flue gases, based on the scrubber and venturi method, and gas washing in a foam layer, are discussed. Some calculations, subject to operating figures, are given with the view of designing a venturi scrubber. Some types of equipment and the gas scrubbing operation are presented based on bibliographic information. Systems of heat recovery in flue gases are also described. Some suggestions are given regarding the erection of a venturi scrubber or a washer with foam layer in sulfate pulp mills.

30062

Davis, John C.

PULPERS APPLY ODOR CONTROL. Chem. Eng., 78(13):52-54, June 14, 1971.

Total reduced sulfides from the pulping industry, composed mainly of hydrogen sulfide, can be detected by the human nose at a concentration of 1-5 ppb. To get below the threshold for smell at ground level, the stack concentration of total reduced sulfides cannot be much more than 1-5 ppb. To reduce H2S emissions, Babcock and Wilcox has designed out the evaporator. The three main design changes in the recovery boiler are: an increased reliance on forced circulation of liquor through the exchangers; a revised tube-surface arrangement to offset sealing and poorer rates of heat transfer; and a steam pressure limit of 35 psig coming into the multiple-effect train. The Combustion Engineering Corp. offers five recovery boiler designs that can be tailored to fit a specific pulpmill. Despite its economy, oxidation has been abandoned in many pulpmills in the southern U. S. due to excessive foaming in weak black liquor. However, the tonnage oxidation system, operated by Owens-Illinois, reportedly has solved this problem; a 94-97% efficiency is claimed in converting sulfides to thiosulfates. Western Kraft Corp. has introduced another type of stack gas cleaning, namely, scrubbing with a weakly alkaline wash liquor.

30208

Estridge, R. B., B. G. Turner, R. L. Smathers, and L. J. Thibodeaux

TREATMENT OF SELECTED KRAFT MILL WASTES IN A COOLING TOWER. TAPPI, 54(1):53-59, Jan. 1971. 10 refs. (Presented at the Association of the Pulp and Paper Industry, Waste and Air Conference, Minneapolis, Minn., June 7-10, 1970.)

Pulp mill condensates and decker filtrate from an 850-ton/day kraft linerboard mill have been successfully treated in a conventional cooling tower. These waste streams, in combination with the condenser waters from a barometric type evaporator condenser, are cooled in the tower and reused. The overall accomplishment of this process is the removal of about 10,000 lb of Biochemical Oxygen Demand (BOD) per day and the reduction in overall mill water needs of about 1,000,000 gal/day. Treatment efficiencies of 65-85% for pulp mill condensates and about 40-50% for combinations of decker filtrate and pulp mill condensates were obtained. The reduction in BOD of these waste streams is believed to be due primarily to the stripping of methanol and other volatiles. Some biological activity is evident, however, and the addition of nutrients results in an improvement of five to 10% in BOD removal. The system has several advantages over the conventional surface condenser system used with kraft mill evaporators. Both operating and capital costs compare favorably with other waste-treatment methods. (Author abstract)

30339

Jonsson, Sven-Erik

EVAPORATION OF BLACK LIQUOR: DEVELOPMENT TO DATE FROM THE STANDPOINT OF ENVIRONMENTAL PROTECTION. (Industning av svartlut: Nagra utvecklingslinjer hittills fran miljovardssynpunkt). Text in Swedish. Svensk Papperstid. (Stockholm), 7:191-196, April 15, 1971.

Three problem areas in the evaporation of black liquor are: reducing the loss of solids (containing sodium sulfate); recovering sulfur compounds from liquid and gaseous wastes; undesirable biochemical oxygen demand of condensates. The volatile sulfur compounds liberated by the evaporation of black liquor are 80-90% hydrogen sulfide, the remainder consisting of thiols. Unless measures are taken to prevent it, sulfur compounds will be found partly dissolved in the condensate and water from the vacuum pump set, while part will be liberated in the form of uncondensable gases. The oxidation of black liquor has a history of 40 years. In more recent times the Uddeholm method has been used to recover sulfur compounds from the liquid and gas phases. The condensate is purified in a column, which removes almost 100% of the sulfur compounds. Gases with an unpleasant odor are collected and neutralized by means of combustion. Another new method is the Delary system, which is also described.

30577

Koelbel, Herbert and Joachim Schulze

THE LONG-TERM TECHNICAL AND RESEARCH PLANS IN THE CHEMICAL INDUSTRY. II. AIMS AND METHODS OF RESEARCH PLANNING. (Die langfristige technische Vorausschau und Forschungsplannung in der chemischen Industrie. II. Zielsetzung und Methoden der Forschungsplanung). Text in German. Chemiker Ztg. (Heidelberg), 95(12):537-547, June 1971. 42 refs. Part I. Ibid., vol. 95:395-405, 1971.

The tolerance limits for pollutants emitted by the chemical plants are met, to a large extent, by dilution or by changing the location to unpolluted areas without set limits. Soon, such methods will no longer be sufficient. Also, the costs for these methods are rising. To cite an example, the 200 m high stack built by the Shell Refinery in Pernis was five times as expensive as the 100 m high stack previously in use and ten times as expensive as the 50 m stack which was first in use. A suitable alternative would be the avoidance of pollutants by process changes, as is being done by the Bayer-Double-Contact process for sulfur dioxide oxidation. Such process changes will be more economical in the future than any other method. In the cellulose and paper industry, and in iron and steel pickling stations, the chances of economically recovering pollutant materials are good.

31072

Kosaya, G. S.

OXIDATION OF BLACK LIQUOR WITH OXYGEN. Bumazhn. Prom. (Moscow), 31(6):15, June 1956. 4 refs. Translated from Russian by Brenda Jacobsen, Washington Univ., Seattle, Dept of Civil Engineering, 5p., Sept. 28, 1970.

Black liquor containing 7.54 gm/l sodium sulfide (Na2S) and 7.4 gm/l sodium sulfite (Na2S203) was oxidized with 100% oxygen, and the effects of temperature, contact time, and intensity of mixing investigated. At 70 C, oxidation of Na2S was completed within a few minutes. The bulk of the sulfide was oxidized to thiosulfate, a part to sulfate. The observed oxygen consumption was 370 cu m/metric ton Na2S, or about 20 cu m oxygen/metric ton of pulp. Oxidation of black liquor with pure oxygen is simpler and more convenient than oxidation by aeration, and has the important advantage of causing no foaming. (Author abstract modified)

31091

Honda, Keisuke

PULP EFFLUENT TREATING DEVICE. (Parup haieki shori sochi). Text in Japanese. (Mitsubishi Heavy Industries, Ltd. (Japan)) Japan. Pat. Sho 46-12521. 5p., March 31, 1971. (Appl. Feb. 13, 1968, 1 claim).

Among the defects of conventional boilers for burning pulp effluent are evaporation of volatile substances in the effluent, reduction of the calorific value of effluent solids on contact with high-temperature gas, and conversion of sulfur oxides and carbon dioxide in boiler exhaust gas to sulfuric acid and carbonic acid. The latter compounds react with the sulfides in the effluent to generate odorous hydrogen sulfide, which lowers the calorific value of solids. High H2S concentrations are harmful to man. The improved equipment described eliminates these problems with an effluent condensation device and an incinerator for heating air. This incinerator is located in the air passage. The condensation device permits direct contact between pulp effluent and heated air and evaporates water from the effluent. Air and condensed pulp from the device are jetted to the incinerator for pulp. The equipment thus has two systems. In the first, air is passed through the air incinerator and condensation device to the air outlet. In the second, or bypass system, air goes through an air-adjustment device. The two systems join at the air outlet of the condensation device, where air temperature is measured to insure that both it and that of condensed effluent are at specified levels. For this purpose, both the air volume adjustment device and the air incinerator are controlled. Because correct temperature is maintained, there is no corrosion problem due to high-temperature air.

31125

Honda, Keisuke

PULP EFFLUENT TREATMENT METHOD. (Parupu haieki shori hoho). Text in Japanese. (Mitsubishi Heavy Industries, Ltd. (Japan) Japan. Pat. Sho 46-13922. 4p., April 14, 1971. (Appl. April 17, 1968, 1 claim).

Effluent from sodium-based pulp processes can have a solid concentration of 15-18% and a pH of 1.5-3. If the untreated effluent is introduced directly to the concentration and combustion processes, expensive, corrosion-resistant equipment is required and air-polluting sulfur compounds issue from the recovery boiler. The invention adjusts the quality of the effluent in the condensation, incineration, and chemical recovery processes. Also, most of the sulfur oxides and a part of the carbon dioxide are recovered. The compounds are either mixed with the effluent to promote the breakdown of pulp, or are extracted and led to other reaction equipment. Sodium, sulfur dioxide or sulfur trioxide compounds from the incineration process in the recovery kiln are recovered as sodium sulfide, converted to carbolic acid and sulfuric acid, and further processed into chemicals for breaking down pulp. Extracted carbon dioxide is used as a raw material for carbolic acid. The following processes thus characterize the invention: addition of carbolic acid soda to effluent to make it alkaline; jetting of alkalized effluent into boiler exhaust gas for absorption of sulfuric acid and carbolic acid gas; heating of the sulfuric acid-containing effluent to break sodium bicarbonate down into carbolic acid soda, carbon monoxide, and water; extraction of CO and water generated in previous processes outside the treatment system.

31308

VIEWS OF THE LUMBER INDUSTRY ON THE ACTIVITY ON THE SWEDISH WOOD RESEARCH INSTITUTE. (Skogindustrins synpunkter pa verksamheten vid Svenska Traforskningsinstitutet). Text in Swedish. Svensk Papperstid. (Stockholm), 74(4):99-103, Feb. 28, 1971.

A report by the managing director and technical director of the Swedish Wood Research Institute to about 20 wood processing industries is summarized. The purpose of the contacts was to obtain opinions on the effectiveness of the Institute. Brief mention is made of the relationship between the STFI and another institute, the IZL, apparently engaged in the control of air and water pollution. The responsibility of the STFI Research should be limited more or less to the problems of the occupational rather than the general environment, although there should be cooperation between the two agencies. The specific environmental problems studied by the institute in 1970 included the possibiliies of reducing the fiber and lignin content of effluents, reduction in the consumption of water in the manufacturing processes, and the removal of hydrogen sulfide and sulfur dioxide from combustion gases and from the fumes emitted by the soda pans. No further details are given on the specific projects.

31463

Blue, Jerry D. and William F. Llewellyn

OPERATING EXPERIENCE OF A RECOVERY SYSTEM FOR ODOR CONTROL. Tappi, 54(7):1143-1147, July 1971. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Engineering Conference, Denver, Colo., Oct. 25-29, 1970.)

The first operating experience of a control odor recovery system at the Halsey, Oregon, kraft pulp and paper mill of the American Can Company has consistently shown daily average total reduced sulfur emission levels of approximately 1.0 ppm, with sulfur dioxide emissions below 200 ppm. The recovery boiler design eliminates direct-contact evaporation and fires unoxidized black liquor supplied directly from multiple-effect evaporators. The operation has met or exceeded predicted emission limits. A collection and thermal oxidation system for miscellaneous emission sources has also contributed to mill operation essentially without odor. (Author abstract)

31608

Coats, Gus S.

OPTIMIZATION OF ELECTROSTATIC PRECIPITATOR OPERATION THROUGH A COMPUTERIZED MONITORING PROGRAM. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 20p., 1971. 11 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-88.)

A continuous monitor and a computer have been combined to improve the performance and maintenance of an electrostatic precipitator a kraft recovery furnace. The monitor selected for this operation was an instrument which operates by the measurement of the loss in light transmission through a dust laden gas. Following the calibration of the monitors, the operating reports and charts were studied to determine the precipitator parameters that could be easily evaluated and reported in a daily emission report. A computer program was developed to handle the manual inputs from the monitors and the selected precipitator parameters.

31790

Buxton, Winslow H., Jr.

PROCESS AND APPARATUS FOR PULP MILL CHEMICAL RECOVERY AND ODOR ABATEMENT. (Western Kraft Corp., Albany, Oreg.) U. S. Pat. 3,574,556. 6p., April 13, 1971. 13 refs. (Appl. March 4, 1969, 8 claims).

A process and apparatus are presented for the recovery of chemicals and the abatement of odors emitted by the recovery furnace of kraft pulp mills. Gases from the discharge stack of the recovery furnace are diverted to an afterscrubber in which they are sprayed with an alkaline weak wash liquor resulting from the washing of calcium carbonate mud and solid dregs produced by causticizing the green liquor. Thus, hydrogen sulfide, mercaptans, and other malodorous gaseous compounds are removed. Corrosion is minimized, heat is recovered, and a problem of waste disposal in the mill effluent streams is avoided. (Author abstract modified)

31794

OXYGEN TREATING IS PROVING FEASIBLE. Can. Chem. Process., 55(4):52-54, 56, April 1971.

Among newer techniques being groomed for use in the pulpmill are soda-oxygen pulping, oxygen bleaching of pulp, and other oxidation systems using oxygen instead of air. One result of such wide use of oxygen would be the need for a tonnage oxygen (air separation) plant at or near most pulp and paper complexes. With tonnage oxygen available, it becomes feasible for existing kraft mills to conduct oxidation of black liquor with oxygen and hence automatically reduce the amount of malodorous off-gases produced in the chemical-recovery system. Similarly, existing biological treatment plants for wastewater could be upgraded in operation through the use of oxygen instead of air as the aeration medium. The use of an oxygen stage and the consequent reduction in chlorine charge to the bleachery introduces the possibility of lowering bleachery pollution by over 50%. Operating variables at several plants are mentioned.

31803

ENVIRONMENTAL FORECAST: INCREASED PRECIPITATION. Chem. Week, 109(7):77-78, 80, 82, Aug. 18, 1971. 1 ref.

In the past five years, the range of application of electrostatic precipitators has been extended from atmospheric pressure to as high as 825 psi and from temperatures below 900 F to 1700 F. Precipitators are also being designed to handle dust concentrations from 0.00001 grains/std cu ft to 156 grains/std cu ft and efficiencies over 99%. Coal-burning electric stations, the steel industry, the pulp and paper industry, and contact sulfuric acid plants continue to be important markets for electrostatic precipitators. Precipitators are also used in processing cement and gypsum. New or potential fields of application include Wulff acetylene production, removal of lube oil mist from gas pipelines, shale-oil processing, and coal gasification.

31991

Eggert, Walter C.

APPARATUS FOR THE PREVENTION OF AIR AND WATER POLLUTION IN THE MAKING OF WOODPULP FOR PAPER MAKING. (Assignee not given.) U. S. Pat. 3,581,897. 5p., June 1, 1971. 2 refs. (Appl. Dec. 15, 1969, 10 claims).

When water containing residue chemicals used in the making of woodpulp is admitted to the smoke stack, it combines with steam generated by sulfurous gases from fuel oil and black liquor to produce a large volume of hydrogen sulfide. The polluting water also cools the stack gases and retards draft, preventing the gases from going as high into the atmosphere as they normally would. Air and water pollution are avoided by passing the residue liquid through a duct to a series of water spray chambers, where the liquid is cooled and combined with the water spray. The resulting liquid is then led to a covered receiving tank having a sloping bottom for collecting chemical sludge. The receiving tank has filter trays for filtering the liquid rising to the upper portion of the tank and an overflow pipe for draining off the filtered liquid. There is also a lower drain conduit for draining off the chemical sludge to a separate collection point. (Author abstract modified)

32018

Galeano, Sergio F. and Byron M. Dillard

PROCESS MODIFICATIONS FOR AIR POLLUTION CONTROL IN NEUTRAL SULFITE SEMI-CHEMICAL MILLS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 25p., 1971. 8 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-87.)

In the kraft process, a ton of wood chips generally will produce about a half-ton of pulp, or a yield of 50%, while the semi-chemical process will produce a yield of 80%. Sulfur compounds are active cooking ingredients in the production of 95% of the pulp made by chemical or semi-chemical processes. In the last five years, however, the pulping industry has made significant advances in reducing sulfur gaseous emissions through process modifications and source control. Different process modifications introduced at one mill in Tomahawk, Wisconsin, and another in Big Island, Virginia, are described. The methodology and concepts used to minimize total reduced sulfur and total sulfur oxide emissions from the recovery furnace of the Tomahawk operation are explained. Thermodynamics of the combustion process and proper turbulence were instrumental in achieving reduction of sulfur compound emissions from this unit. Conventional hydrogen sulfide emissions from the sulfiting tower, on the order of eight to 10 pounds per ton of pulp, have been completely eliminated by a process modification technique in the Big Island mill. Primary air requirements, the amount of secondary air needed, and the optimum degree of turbulence are indicated. Control of nitrogen oxides is also discussed. It is important to remember that whenever steps are taken to reduce water pollution levels by chemical recovery, air pollution problems are increased in a chemical pulping process.

32109

Ogisu, Yoshihiro

COMBUSTION OF PULP WASTE LIQUOR. (Parupu haieki no nensho). Text in Japanese. Kogai (Hakua Shobo) (Pollution Control), 6(3):12-19, May 1971. 14 refs.

General pulp waste liquor combustion methods are reviewed. Representative combustion processes designed to take care of Kraft pulp (KP), sulfurous acid pulp (SP), and semi-chemical pulp (SCP) waste liquors are examined. About 95-98% of the KP waste liquor is concentrated and burned in the recovery boiler to recover the chemical for reuse as the cooking liquor and reclaim heat from the vapor. The recovery boiler designed to dispose of the KP waste liquor for recovery of chemicals and heat developed about 35 years ago and widely used ever since, is briefly described. To eliminate the highly offensive odor from the exhaust gas it emits, the recovery boiler is often combined with a cyclone or venturi scrubber. Techniques for manufacturing alcohol, yeast and lignin from the SP waste liquor are not necessarily economically feasible. SP waste liquor is usually incinerated in a furnace equipped with the Loddby burner. The SP waste liquor containing 55% solids has a viscosity of about 60cp at 75 C and 20cp at 100 C, so that it is atomized for combustion. The solid content of the SP waste liquor has a calorific value of about 4500 kcal/kg, so that the SP waste liquor can be burned without auxiliary fuel. SCP waste liquor, similar in character to KP waste liquor, is concentrated and burned by means of the recovery boiler. The Scottish Pulp Co. of Britain is reportedly manufacturing SCP while recovering the chemicals by Stra-Process. The recovery boiler used in the process is a similar to that used for the KP waste liquor. The wet oxidation method, Copeland process and atomized suspension technique, designed for the combustion of SCP waste liquor, are also discussed.

32569

Collins, T. T., Jr.

THE SCRUBBING OF SULPHATE RECOVERY FURNACE STACK GASES. PARTS I, II, III. Paper Ind. Paper World, vol. 29:680-686, 830-834, 984-987, Aug., Sept., Oct. 1947. 14 refs.

A pilot plant was designed to test the scrubbing efficiency of a wet cyclone scrubber and a venturi scrubber. The operation of both, in the recovery of sodium salts from a sulfate recovery furnace stack, is described. The results of sampling stack gases from the furnace and gases leaving the scrubber for total sulfur, sulfates, sulfites, thiosulfates, hydrogen sulfide, and sulfur dioxide indicate that the venturi scrubber is as efficient on fine fumes as the scrubbers which have been previously designed. It successfully washes gases with less liquid than is used in other scrubbers. The optimum values with proper throat distribution and gas velocities appear to range from three to six gallons/1000 cu ft of entering gas. Under the conditions of gas velocity and liquor rate in the venturi throats used in this investigation, the droplets atomized in the throat were coalesced or impinged on the walls before they reached the outlet of the venturi section. The break-up of the streams of water due to the energy of the gas results in the formation of filaments and droplets of liquid under conditions of extreme turbulence and violent mixing of the gas and liquid.

32603

Burnova, G. P. and V. I. Kostrikov

PURIFICATION OF AIR FROM HYDROGEN SULFIDE AND CARBON DISULFIDE IN THE CELLULOSE PRODUCTION. (Ochistka vozdukha v proizvodstve viskozy ot serovodoroda i serougleroda). Text in Russian. Zh. Vses. Khim. Obshchestva im. D. I. Mendeleeva, vol. 14:399-404, 1969. 5 refs.

The application of various mythods of the purification of flue gases containing hydrogen sulfide and carbon disulfide from cellulose production is discussed. The oxidation iron-soda and alkali-hydroquinone methods for purification of flue gases from H2S are analyzed in detail. The mechanisms of both processes is shown, the industrial realization is described, and technical data is presented. Purification is better than 20-30 mg/cu m. For purification of gases from CS2, two methods are described: 1) Purification in a stationary layer of active coal and 2) Purification in a suspended layer of active coal. The industrial designs of both are described, the technical and economic data compared. A new method is described, consisting of the simultaneous catalytic oxidation of H2S and adsorption of CS2 on active coal. Periodic addition of ammonia neutralizes sulfuric acid formed in the process, thus preventing the loss of coal activity. A purification method based on low-temperature contact combustion of H2S and CS2 to SO2 is briefly discussed.

32615

Kleppe, Peder J.

THE CONTRIBUTION OF INPLANT CONTROLS AND PROCESS MODIFICATIONS TO POLLUTION ABATEMENT IN THE PULPING INDUSTRY. North Carolina Univ., Chapel Hill, Dept. of Environmental Sciences and Engineering, Proc. S. Water Resour. Pollut. Contr. Conf., 18th, Raleigh, N. C., 1969, p. 85-100. 45 refs. (April 9-10.)

Air and water pollution, as caused by the pulping industry, and some control methods are discussed. Water pollution may originate in the woodyard, pulp mill, bleaching plant, or paper or board mill; several methods of reducing this pollution are given. The condensate and non-condensed materials from the evaporators are the major sources of air pollution. In the Kraft process, the non-condensable gases, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and hydrogen sulfide, are responsible for the characteristic odor. The main pollutant from the combustion furnace is sulfur dioxide. Air pollutants from the liquor preparation are H2S, organic sulfur compounds, SO2, and particulates from the lime kiln. Oxidation of spent kraft liquor before evaporation converts the sulfide to thiosulfate; the sulfur losses by evaporation can be almost eliminated if oxidation is complete. Mercaptans are also oxidized to the less odorous dimethyl disulfide. A reduction in the sulfidity of the cooking liquor and an increase in the alkali charge can reduce pollution caused by sulfur. The vent gases from condensation of blow and evaporator-vapors can be freed of H2S and mercaptans by scrubbing with alkali pulping liquor. The vent gases from the melt dissolving tank and lime kiln are also purified by scrubbing. As much as 85% SO2 removal can be achieved by absorption by a sodium sulfite solution in a venturi scrubber. Particulate emissions from recovery furnaces are reduced with electrostatic precipitators. The present status and future trends in pollution abatement are also discussed.

32681

Adams, Donald F.

PULP AND PAPER INDUSTRY. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 39, p. 243-268. 45 refs.

Odorous and particulate emissions are potential by-products from many of the steps in kraft and sulfite pulping processes. In the kraft process, such odorous compounds as methyl mercaptan, methyl sulfide, and hydrogen sulfide are emitted by the digestors and evaporators; lime kilns emit H2S and dusts. In the chemical recovery process, methyl mercaptan, sulfur dioxide and H2S may be discharged. Several methods are available for controlling the gaseous emissions, including black liquor oxidation, combustion of organic sulfur compounds to convert them to SO2, chlorine oxidation, oxidation by air or ozone, scrubbing, absorption by charcoal, and waste heat recovery. Modern equipment for controlling particulate emissions includes electrostatic precipitators, venturi scrubbers, wet cyclones, and de-mister pads. The sulfite pulping process is briefly discussed. Analytical methods used in stack and field sampling are also reviewed. Mercaptans and H2S are determined iodometrically. Sulfur dioxide is measured colorimetrically using the modified West and Gaeke method. Flame ionization detectors have been successfully used in the analysis of organic compounds in kraft mill gases. Instrumental methods for analyzing effluents and suggestions for future research are also given.

32768

Okayama Prefecture (Japan), Industrial Experiment Station

DEODORIZATION AND REMOVAL OF BAD-SMELLING GAS. (Akushu gasu no dasshu jokyo ni tsuite). Text in Japanese. Okayama-ken Kogyo Shikensho Nyusu (Okayama Prefect. Expt. Sta. News), no. 110, 2p., April 1971.

The most effective deodorization is direct burning whereby bad odor gases are sent to a combustion chamber or furnace and burned at a temperature higher than 800 C. However, more than 90% of the material must be oxidized and turned into carbon dioxide, nitrogen dioxide, nitrogen, or sulfur dioxide. When the combustibility of the material is low, use of oxidation catalysts such as platinum-palladium or platinum-rhodium will enable hydrocarbons to oxidize completely and decompose at 260-320 C. These catalysts are unsuitable for treatment of gases which will create catalytic toxins such as sulfur, zinc, mercury, lead, arsenic, fluoride, and tin. Free of contact with such elements, these catalysts will last for 30,000 to 40,000 hours and still be reclaimable. Another deodorizing method which is frequently used in Japan is washing with water, saline water, acids, or alkalies. Water is effective for solubles such as ammonia and amines; acids should be washed with alkalies, and alkaline gases should be washed with acids or should be oxidized by chlorine, chlorine dioxide, or potassium permanganate. Activated carbon is used for the absorption method. Gas washing and adsorption combination can be effectively employed for deodorization of ammonias and amines. The ozone-oxidation method is mainly used for sewage treatment. The amount of ozone required for sewage treatment is reported to be 1 ppm; for restaurants, 5 ppm; fish canneries, 10 ppm; and paper pulp mills, 10-50 ppm. For masking odors, acetic acid benzene, heliotropine, and vanillin are used. More than forty kinds of air wicks, mostly manufactured from plant extracts and chlorophyll, are used for neutralizing different odors.

32798

Ishii, Tomio

AIR POLLUTION (ODOR) CONTROL FOR KRAFT PULP MILL WITH OZONE. (Taiki osen (shuki) to kurafuto parupu miru no ozon dasshu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):824-828, Sept. 1971. 6 refs.

A pilot odorimeter was tested in 1970 in England wherein the upper part of the test tube had a heated coil which lighted mixed gas. The flame rapidly spread below and formed dispersed light. Sample gas was passed into the tube from the lower opening and through the burner at the speed of 7 m/sec; the light continuously scattered at the narrow point of the tube and reached the upper part of the water jacket which enveloped the tube. The intensity of the light was photoamplified and was sent to a penrecorder. At the test site, methylmercaptan was discharged for five minutes at a height of two meters from the ground, 100 meters windway from the measuring point. The record showed a wave pattern with six or seven large peaks, probably due to the breeze. But the test was deemed successful. In the United States, the Kraft Pulp Mill s deodorization process by ozone is an example of successful treatment of industrial odor problems. In the process of chemical digestion of pulp, hydrogen sulfide and methylmercaptan are emitted and create odor. According to a study, 1000 kg of pulp creates 114.2 g H2S and 824.1 g of mercaptan at the Kraft Pulp Mill. The main sources of emissions are the stacks of the black liquor combustion furnace; discharge from the digester; waste gas from the blowdown; and the non-condensable materials from the evaporator and vacuum pumps. Oxidation of the gas from the black liquor stack solved that particular problem, but the main source of odor was the blowdown which oxidation did not help. More recently, waste gases at this mill are treated through condensers where ozone is added to the gas at the entrance and exit, and has proved successful. The duration of gas-ozone contact is also important, and a 2.2 sec exposure gave the best result.

32937

Gommi, J. V.

OPERATING PERFORMANCE OF A RECOVERY BOILER ODOR CONTROL SYSTEM. Tappi, 54(9):1523-1526, Sept. 1971. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Engineering Conference, Denver, Colo., Oct. 25-29, 1971.)

The air contact evaporator system was developed as a means of removing the source of the hydrogen sulfide odor in Kraft recovery furnaces. An air heater transfers the heat from the exiting gases to the incoming clean air; this heated clean air is then routed to a cascade evaporator where it removes moisture from the black liquor. The system retains and reinforces the operating philosophy which maximizes chemical conversion and recovery, and minimizes unburned fuel and sulfur emissions. This is achieved by proper attention to spray droplet size, hearth bed shape, primary to secondary air ratio, and sufficient secondary air pressure to take advantage of the tangentially fired turbulence available in the furnace design. Two contact evaporator systems are discussed and are operated below code requirements for toal reduced sulfur compounds. Operating problems are considered, as well as recent operating experience.

33073

Adalberto, Tirado A.

PROCESS DESIGN FOR POLLUTION CONTROL IN INDUSTRIAL PLANTS. Print, American Inst. of Chemical Engineers, New York and Inst. Mexicano de Ingenieros Quimicos, 13p., 1970. 6 refs. (Presented at the American Institite of Chemical Engineers, Institute Mexicano de Ingenieros Quimicos Joint Meeting, 3rd, Denver, Colo., Sept. 2, 1970.)

Principles of process design for pollution control in industrial plants were discussed. Modern process design must consider the plant and nature as a whole. The principles used to control odors in a Kraft pulp plants were given. Tendencies or potentials can only be modified by tendencies or potentials of the same nature. Material and energy balances are always true. Energy should tze used in a cascade. Internal recycling to change temperature, concentrations, flow rates, and equilibria without affecting the external energy and material balances is a useful tool in fighting pollution. In pulp mills, contaminated water is recycled to increase the recovery of fibers or other substances and, at the same time, save substantial quantities of water.

33347

Oglesby, Sabert, Jr.

ELECTROSTATIC PRECIPITATORS TACKLE AIR POLLUTANTS. Environ. Sci. Technol., 5(8):766-770, Sept. 1971.

The largest single use of electrostatic precipitators is controlling fly ash emissions from coal-fired electric power boilers. The most significant properties of fly ash are its resistivity, particle size, and cohesiveness. If the resistivity is high, the current and voltage at which the precipitator can operate are reduced; if the resistivity is low, excessive reentrainment of the dust can occur. Resistivity of fly ash is dependent on the properties of coal and ash and on flue gas temperature. One solution to the high resistivity problem is reducing flue gas temperature to increase moisture and sulfur trioxide adsorption on the fly ash surface. An alternate approach to reducing gas temperature is increasing combustion air flow through the air heater and discarding excess air or using it to reheat the flue gas. Other approaches are cited. During recent years, there has been a decided trend toward installing a precipitator ahead of the air heater in electric power generating plants. Advantages of these hot precipitators are mentioned. Controlling effluents from recovery boilers in the pulp and paper industry constitutes another large application of electrostatic precipitators. Metallurgical uses, wet precipitators, cement kiln applications, and municipal incinerators are also discussed. Future applications are considered.

33715

ECONOMIC CLEANING OF WASTE AIR. (Wirtschaftliche Abluftreinigung). Text in German. Umwelt (Duesseldorf), 1(5):55, Oct./Nov. 1971.

Many industries try to clean their waste gases by simultaneously recovering chemicals. Solvent vapors can be drawn off from the production machines, mixed with air, and cleaned. Several methods are available for recovery, including the adsorption method with activated coal or the condensation method. Other waste gas cleaning methods without recovery are scrubbing with a suitable scrubbing fluid and subsequent separation of the scrubbing fluid through rectification or chemical reaction and thermal or catalytic combustion of the solvent vapors. In many cases the adsorption method is the most economical. In a paper mill, 80,000 cu m air are drawn off/hr containing vaporous toluene at a concentration of 12.5 g/cu m. The investment costs for a waste gas cleaning system based on the adsorption method are about $17,000 including capital costs. At a plant efficiency of 98%, 980 kg toluene/hr are recovered. Through the sale of the toluene, it takes just 315 days to cover the investment costs. Thereafter the system operates with profit.

33732

Walther, James E. and Herman R. Amberg

THE ROLE OF THE DIRECT CONTACT EVAPORATOR IN CONTROLLING KRAFT RECOVERY FURNACE EMISSIONS. Pulp Paper Mag. Can. (Quebec), 72(10):65-67, Oct. 1971. 10 refs. (Presented at the Canadian Pulp and Paper Association, Technical Section, Annual Meeting, 57th, Montreal, Quebec, Jan. 26-29, 1971, Paper T305.)

A study was made of total reduced sulfur and sulfur dioxide emissions from several conventional kraft recovery furnaces using direct contact evaporation and a newer designed furnace without a direct contact evaporator. Sulfur emissions were measured with Barton sulfur titrators. The direct contact evaporator did not emit total reduced sulfur when the black liquor sodium monosulfide content was less than 0.5 g/l and the pH was 12 or higher. Although average recovery furnace total reduced sulfur emissions were less than 5 ppm, average SO2 concentrations ranged from 150 to 680 ppm. The direct contact evaporator removed about 75% of the SO2 emission and up to 50% of the furnace total reduced sulfur emission, when total reduced sulfur concentration exceeded 5 ppm. (Author abstract modified)

33918

Okumura, Eijiro and Hiroyasu Matsumoto

DESIGN OF FLOATING SCRUBBER AND TURBULENT ABSORBER. (Shisshiki shujin oyobi gasu kyushu sochi no sekkei - Furotingu sukurabba, taburento abusoba ni tsuite). Text in Japanese. Kagaku Sochi (Plant and Process), 9(10):11-22, Oct. 1967. 4 refs.

The Floating Scrubber (FBWS), wet type dust collection device, and the Turbulent Absorber (TCA), a gas absorption device, were discussed including their basic mechanisms, construction, and design theories. Practical applications include dust removal in iron manufacturing plants; dust removal, sulfur dioxide recovery, and gas absorption in pulp factories; dust removal in steel manufacturing dust removal in sulfuric acid manufacturing plants; absorption of SO2 from waste gas in H2SO4 manufacturing plants; recovery of fluoride compounds from waste gas phosphoric acid manufacturing industry and from waste gas in aluminum manufacturing industry. Both the FBWS and TCA are scrubber columns filled with lightweight plastic balls between two grids. The washing liquid is sprayed through a nozzle from above and the gas to be treated is fed in from below; the gas causes a violent turbulent motion as it ascends to contact the wash liquid. Since the gas-liquid contact system occurs in the space between the two grids, the balls contact the media, float with the gas and liquid. Since the gas-liquid contact system occurs in the space between the two grids, the balls contact the media, float with the gas and liquid, revolve, and hit each other, thus causing stirring. This keeps the surface of the balls clean so that a new liquid film can form. Also, the area of contact between the gas and the liquid is enlarged for effective dust collection and gas absorption. The constant stirring keeps the grid meshes free from viscous or other substances formed by the absorption reaction. This is known as self-cleaning. Both FBWS and TAC are patented to UPO of the U.S.A. and feature no clogging, even with viscous substances; low pressure loss compared with its high gas velocity; higher contact effect resulting in higher efficiency; and stable and long-life performance.

34044

Miyagi, Hiroshi

DUST COLLECTION OF PAPER PULP INDUSTRY. (Kami parupu sangyo no shujin ni tsuite). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 7(10):575-580, Oct. 1971.

In the paper pulp industry, both sulfite process and the Kraft Process create dust particulates, but the latter is particularly troublesome. Dusts are created by the dissolver emission pipe, the burned lime bin, and the caustic tank emission pipe, but the recovery boiler flue and the rotary kiln produce especially large quantitites of dusts. The main component of the flue gas from a plant with a 500 t/day production capacity is 8-15 g/N cu m, or 40 - 70 t/day of mirabilite (sodium sulfate). Most plants use electric precipitators behind the recovery boiler, and most precipitators collect 90-98% of dusts. However, when the dust collection rate is only 90%, the stack gas sometimes contains more than one g/N cu m of NaSO4, exceeding the air standards of the Air Pollution Control Law. In such cases, installation of a second dust collector is necessary, but this is not feasible for most plants because of the space involved. Usually a wet scrubber is used, but the design of a high efficiency scrubber is extremely difficult, due to the small size of NaSO4 particles. However, the weak alkaline liquid which circulates between the recovery boiler and the caustisation (?) plant in a KP mill can be utilized for the scrubbing of gas, which reduces the cost of fresh alkali. The rotary kiln produces 20-70 g/N cu m dusts. The main components are calcium carbonate (CaCO3) and calcium oxide (CaO), and a plant with 500 t/day production creates approximately 24 t/day of CaCO3 and CaO. About 97-98% of dusts must be collected in order to meet the minimum air standard. Scrubbing of the gas may be achieved by diluted chemicals, but industrial water is sufficient, and desulfurization is achieved at the same time by CaO. The sulfur dioxide content in the emission gas after the treatment is almost zero.

34299

Freyschuss, Stig

MODERN METHODS FOR THE REDUCTION OF THE WASTES FROM CHEMICAL PULP MILLS IN SWEDEN. Water Air Ind., Proc. Int. Cong. PRO AQUA, Basel, Switzerland, 1969, p. 128-141.

Chemical pulp production has increased greatly in Sweden during the last 25 years, which has caused many severe pollution problems in lakes, rivers, and along the coast of the Baltic. During the last 10 years intensive work has been going on to reduce the waste mainly by internal measures in the chemical pulp mills. There has been a reduction of the fresh water consumption for the pulp processes which has made it possible to recover more of the wastes both in the form of dissolved organic material and fibers. Development of the continuous digester for the sulfate process has been of great importance for development of better washing methods, which means less pollution from the black liquor. The steam stripping of the condensates has reduced the loss of orgainc sulfides and methanol to the recipient. By burning the uncondensable gases after stripping, part of the air pollution problem has found a solution. The evaporation and burning of the spent sulfite liquor is the only effective way of solving the pollution problems at Swedish calcium sulfite mills. Development of efficient washing methods has decreased the loss of sulfite liquor to about 15%, and by using soluble bases such as magnesium or sodium the recovery of spent liquor can be increased to at least 95%. Cross-recovery of chemicals is also mentioned. (Author summary modified)

34317

ENVIRONMENT PROTECTION CITATIONS. Power, 115(11):S2-S9, Nov. 1971.

Industrial plants that proved how sound engineering could produce results in a determined effort to clean up plant-water effluent are cited. Mathematical modelling was utilized by International Paper to evaluate the influence of waste discharge into a lake. Starting with the basic equation for distribution of a contaminant under steady-state conditions, a series of equations were developed for use with a computer program to yield, amongst other variables, biological oxygen demand and dissolved oxygen profiles for the lake. The pollution-free operation for a new mill with a continuous digester using the proven kraft process is described. An ash collector and the sulfite pulping process are mentioned. Activated sludge, tertiary treatment, and incineration are described for the control of refinery problems. Waste waters are collected in sumps at key locations, then pumped to treatment tanks. Chrome is reduced with sodium bisulfite and precipitated with caustic, and cyanide is oxidized with sodium hypochlorite. Treated solutions are pumped to blending tanks where the pH is adjusted. Waste streams containing suspended solids, hexavalent chrome, and floating matter are treated with antifoam and coagulating agents before entering an air mixing tank. After aeration, waste water flows to a series of settling tanks where suspended and floating solids are removed. The recently started-up purification plant to handle acidic rinse water plus wastes from chrome plating is also described. Other control methods mentioned include black liquor oxidation, electrostatic precipitators, odor counteraction, venturi scrubbers, cyclones, and filters.

34385

Kalish, John

EUROPE S LARGEST KRAFT DIGESTER COMES ON STREAM AT BILLERUD. Pulp Paper Int., 13(11):51-55, Oct. 1971.

Europe s largest continuous kraft digester -- rated at 940 tons/day -- and a highly advanced evaporation and cross-recovery system highlight the recently completed kraft pulp expansion at the Gruvon mill of Billerud AB in Sweden. About half of the output of the new digester is flash dried market pulp from twin 275-ton/day flash dryers, marking Billerud s entry as a producer of unbleached kraft market pulp. Environmental and emission control at Billerud centers around a very well designed recovery system with several unique features for optimal operation and order reduction. A new technique of splitting the condensates from the black liquor evaporation stages has been employed to isolate contaminated condensates and provide for subsequent destruction of the contaminants. The two present evaporator lines are attached to a 20-ton/hr forced circulation stage for concentration of the thick liquor to 65% solids, considered to facilitate subsequent combustion. Sodium hydroxide is added to the first stage of the stack gas scrubber. The recovery boiler and other details of the recovery system are described. (Author summary modified)

34459

DEVELOPMENTS IN AIR POLLUTION CONTROL TECHNIQUES FOR PULP INDUSTRY. (Luftvardsteknik i utveckling for en renare skogsindustri). Text in Swedish. Svensk Papperstid. (Stockholm), 71(18):579-584, Sept. 1971.

Air pollution problems and control of the Finnish pulp industry are discussed. An emission test group was formed in Sweden to furnish data on hydrogen sulfide and sulfur dioxide emissions by sulfate plants. Sampling, analysis, and sample handling methods are reviewed. The test data serve as a basis for the Nature Conservation Authority in determining standard values for soda plant emissions. Technical conditions of observing H2S emission norms are outlined. Emission measurements are remunerative, as they can contribute to a smoother operation. Three methods were tried to reduce SO2 emission in pulp production (changeover to another base (magnesium), waste gas scrubbing, and precipitation). Test instruments for measuring gaseous sulfur compound emissions around sulfate plants, and two methods for concentration measurements in ppb-range are reviewed. Local emission measurements around three sulfate plants are summarized. With smaller production volume, approximately the same amount of sulfur is emitted by the Finnish pulp industry as by the Swedish. Methods for continuous H2S and SO2 measurements are being studied and developed. It will be possible to reduce sulfite emission by changing over to another base connected with a more intensive regeneration of chemicals. Direct waste gas evaporators cannot meet the requirements in the sulfate cellulose industry. Electrostatic precipitators, and waste gas scrubbers are needed.

34868

Duncan, Leon and Isaiah Gellman

THE AIR POLLUTION CONTROL PROGRAM OF THE NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT. Vanderbilt Univ., Nashville, Tenn. Dept of Environmental and Water Resources Engineering, and Tennessee Stream Pollution Control Board, Environ. Water Resources Eng. Conf., 9th, Annu., Nashville, Tenn., 1970, p. 41-44. (June 4-5.)

During the past 15 years, the National Council of the Paper Industry for Air and Stream Improvement has been actively engaged in a research program aimed toward air quality protection. These efforts encompass such areas as development and application of sampling and analytical techniques, adaptation and evaluation of air pollution control equipment, changes in processes and operations to effect improved atmospheric emission, and applications of new concepts in pulp and paper making operations for more effective emissions control. Currently, the major thrust is in the area of odor control from kraft mill operations.

35315

Freiday, Jay H., West Hartford, and George J. Prohazka

CHEMICAL RECOVERY FURNACE WITH AIR CASCADE EVAPORATORY SYSTEM. (Combustion Engineering, Inc., Windsor, Conn.) U. S. Pat. 3,592,610. 6p., July 13, 1971. 3 refs. (Appl. Dec. 27, 1967, 6 claims).

Chemical recovery systems are used generally in the paper making industry to process and recover the chemicals used in digesting wood or other cellulose material. In a chemical recovery furnace system including a rotary regenerative air heater and an air cascade evaporator, the location of the forced draft fan can be changed from the upstream air inlet side of the air heater to the outlet side of the air stream through the air heater. By relocating the forced draft fan, the absolute pressure through the air side of the system is reduced, thus resulting in a reduction of the differential pressure between the air and gas sides of the rotary regenerative air heater, and a corresponding reduction in the air-to-gas leakage. Relocation of the fan also enables a closed recirculating heat transfer loop to be formed between the recovery furnace and the cascade evaporator through the fan. This feature has great value in effecting safe emergency shutdown when water is believed to be entering the furnace, thus avoiding the possibility of smelt-water reaction explosion.

35519

Hardison, Leslie C.

GAS-LIQUID SCRUBBING TOWER. (Universal Oil Products Co., Des Plaines, Ill.) U. S. Pat. 3,585-786. 5p., June 22, 1971. 4 refs. (Appl. Aug. 12, 1968, 4 claims).

Mass transfer between a liquid and a gas is employed to clean the gas of entrained solids, absorb the gas in the liquid, or react the gas with the liquid. Conventional scrubbers effect mass transfer by bubbling gas through a liquid or by spraying a rising gas stream with a liquid. The former method provides insufficient gas-liquid contact and causes undesirable frothing between liquids and gases. The frothing results in clogged gas inlets and sometimes clogged liquid inlets and gas outlets. The second method provides adequate gas-liquid contact but further increases the frothing. A scrubbing tower with vertically mounted tubes effects mass transfer without creating the turbulence that causes frothing. The upper portion of the tubes, which extend through a partition dividing the upper and lower sections of the tower, is surrounded by a liquid. The liquid flows as a laminar film down the inner walls of the tubes and is contacted by the gas stream rising in the center of the tubes. Applications of the scrubber include oxidizing waste sulfide liquor in paper production, fly ash removal, and extracting nitrogen oxides from tail gas produced by nitric oxide production.

35660

Lardieri, Nicholas J.

PRESENT TREATMENT PRECTICE OF KRAFT MILLS ON AIR-BORNE EFFLUENTS. Paper Trade J., 142(15):28-33, April 14, 1958. 7 refs.

A survey was conducted to ascertain what methods are used for treatment of atmospheric effluents from kraft pulping mills; 58 mills participated. The types of recovery equipment used, specific abatement techniques for various effluents, costs of abatement processes, and the public relations aspects of the problem were considered. The equipment used for collection of particulate matter and aerosols from recovery furnace stacks included electrostatic precipitators (50 mills) and venturi scrubbers (nine mills) two mills used no equipment whatever. Wet scrubbers were used by 54 mills and dry dust collectors by one to control lime kiln exhaust; one mill did not use any control equipment. Odorous emissions from the kraft industry occur primarily from digestion and chemical recovery. Some reduction in these emissions from digester gases is achieved in most Southern kraft mills through the turpentine recovery system. Odors from the black liquor recovery systems arise from the multiple-effect evaporator condensates and from furnace stacks. Methods used to abate odors from these sources are scrubbing of evaporator noncondensables with caustic or black liquor, air oxidation of black liquor prior to recovery, and odor-masking of catalytic reactant compounds. Capital costs are about $1000. per ton of productive capacity.

35793

Oglesby, Sabert, Jr.

ELECTROSTATIC PRECIPITATION. Bull. S. Res. Inst., 26(2):3-9, Winter 1971.

Electrostatic precipitators are assuming new importance as demands increase for better air quality. The three basic steps in the precipitator process are described along with dust properties influencing precipitation and the major uses of precipitators. Precipitators have their widest use in the collection of fly ash from coal-fired boilers at electric power stations and in the collection of dusts from recovery furnaces in pulp and paper mills. Other important users are iron and steel plants and cement plants. The two principal factors governing the ease with which dust can be precipitated are its particle size and electrical resistivity. The trend toward the use of low-sulfur coals is causing problems for fly ash precipitation, as the coals plus a flue gas temperature of 300 F result in high-resistivity dust. This problem can be handled by increasing precipitator size, reducing flue gas temperature, injecting conditioning agents in the gas stream ahead of the precipitator, or increasing the temperature to 600-700 F by putting the precipitator ahead of the air heater. While initial and installation costs of an electrostatic precipitator are higher than for other methods of particulate control, annual operating and maintenance costs are much lower.

35803

Miyajima, Hiroshi

TREATMENT OF EMISSION GAS FROM RECOVERY BOILERS. (Kaishu boira no haigasu shori ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and CCombustion), 38(12):1161-1176, Dec. 1971.

The emission gas from the recovery boiler of a Kraft pulp mill enters an electrostatic precipitator and approximately 95% of eight to ten g/N cu m size dusts are collected. The gas then enters a wet cyclone scrubber and most of 0.4 - 0.5 g/N cu m size dusts are collected and some 0.15 to 0.2 g/N cu m dust particles remain. Altogether, 98 to 99% of the dusts are collected. The dusts are collected mostly by colliding with the spray liquid in the scrubber or diffusing or adhering to the surface of the liquid. The characteristics of this scrubber are its simple structure, easy operation, cleansing operation without power, little draft loss, a wide design possibility for a variety of particle sizes, types, and quantities, a small space requirement, a high collection rate of small particles, its multi-functions, and an excellent anti-erosion capacity. The odor is controlled by an alkaline solution additive in the scrubber liquid which absorbs hydrogen sulfide and mercaptans. The carryover of the dusts from the recovery boiler is successfully prevented by avoiding overloading, increasing the concentration of the black liquor, reducing the inorganic elements in the liquor, reducing the first air supply to the minimum, and decreasing the black liquor jet pressure.

35931

Miyazaki, Shigeru

SO2 SCRUBBER FOR PULP AND PAPER MILL. (Kami parupu kogyo ni okeru haien datsuryu no jisshirei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(12):1108-1114, Dec. 1971.

A Swedish method of stack gas desulfurization was adopted by a pulp mill. The system comprises two conical scrubbers encased vertically in a cylindrical drop collector. The two scrubbers are each connected with a head tank where the absorbent is stored, and a pipe connects the two tanks. The exhaust gas from the boiler is sent to the lower scrubber and passes through the narrow passage between the lower end of the conical scrubber and the surface of the liquid absorbent at a high speed, causing the liquid to turn into aerosol mist and rise upward. The liquid particles have large surface areas and as they rise with the turbulent gas, contacts are made rapidly and effectively with the gas. Sulfur dioxide gas is almost completely absorbed at this stage. The guiding vane attached at the top of the lower scrubber rotates and circulates the gas, and by centrifugal action, makes the liquid drops adhere to the inner wall of the drop collector, and effectively separates the gas from the liquid. Most of the liquid is collected into the lower head tank through the recirculation pipe. The gas treated by the lower scrubber rises to the upper scrubber and escapes into the stack at the top of the drop collector. Fresh absorbent is supplied to the scrubber from the upper head tank and residual SO2 in the gas is effectively absorbed because of the high pH. Carbon dioxide is also absorbed. The absorbent with lower pH comes down to the lower scrubber. The CO2 scarcely reacts to the absorbent of low Ph. The CO2 absorbed in the upper scrubber exists in the form of sodium carbonate and reacts to SO2 and becomes sodium sulfite. The SO2 absorption rate is 95 to 98%, and the dust collection rate is more than 90%.

36018

TWENTY-FIVE THOUSAND NM3/H FLUE-GAS DESULFURIZATION PLANT. Chem Economy Eng. Rev., 4(1):43, Jan. 1972.

In July 1971, with the cooperation of Jujo Paper Co., Hitachi Ltd. built a 25,000 cu Nm/hr semi-wet flue gas desulfurization plant at the Jujo plant in Japan. The process involves reactions in which flue gas is brought into contact with an alkaline solution such as sodium hydroxide. Reaction products are dried by the sensible heat of the flue gas, and the by-product is recovered in the form of a solid powder consisting mainly of sodium sulfite.

36037

Gavelin, Gunnar

AIR AND WATER POLLUTION CONTROL METHODS USED IN SWEDISH PULP MILLS. Paper Trade J., 156(3):34-36, Jan. 17, 1972.

Sweden now has 31 kraft mills producing four million tons of pulp and sewering 180,000 tons of biological oxygen demand and 200,000 tons of lignin per year. All these mills have liquor evaporation, and one of the most important questions is how to improve the washing efficiency. Biological treatment has been installed at one mill, a combination of sedimentation and chemical precipitation at another. What most captures the imagination of kraft mill designers in Sweden today is the possibility of building a completely closed mill, where no external effluent treatment would be required. The bleach plant effluent presents an additional and very difficult problem which will be reduced only by 50% should oxygen bleaching as a first stage become generally adopted. The mercury losses from the chlorine-alkaki plants, on the other hand, have been virtually eliminated by process modifications and closing of the systems. The sulfite mills, which sewer 310,000 tons of BOD and 400,000 tons of lignin per year, have only three choices: converting to soluble base, installation of liquor evaporation with sulfur dioxide scrubbing, or closing down. Sulfur dioxide and hydrogen sulfide emissions present another problem at Swedish pulp mills. Biological and oxygen treatment are mentioned.

36270

HOW WEYERHAEUSER CONTROLS KRAFT ODOR WITH THE VAPORSPHERE. Paper Trade J., 139(1):12-13, Jan. 3, 1955.

At two kraft mills, sulfur-containing gases that are not eliminated by condensers are collected by 25-ft steel bubbles (vapospheres) on the roofs of the mills. Inside each sphere is a rubber- treated diaphragm that expands slowly as the gases are collected and stored. The inflated balloon allows the gases to be drawn off slowly and at a constant rate for destruction by burning or chemical treatment. The devices are at least 90% effective in completely deodorizing the pulping process.

36355

(Inventor not given.)

A METHOD TO REDUCE THE PROPORTION OF SULFUR TRIOXIDE IN OFF-GASES FROM THE COMBUSTION OF SULFUR-CONTAINING OFF-LYES. (Bystroms Oljeprodukter A. B., Karlstad (Sweden)) Brit. Pat. 1,204,761. 1p., Sept. 9, 1970. (Appl. Jan. 1, 1968, 4 claims).

In the method described, magnesium sulfate is added to sulfur-bearing lye along with magnesium tall oil fatty acid soap. The lye is then burned. Incrustation is reduced by the addition of the two mixtures. The method is particularly applicable to reducing sulfur trioxide in sulfite and sulfate cellulose processes.

36478

Dumon, R.

TREATMENT OF LIQUID EFFLUANTS IN A NEW ELF-HEURTY TYPE INCINERATOR. (Traitement d effluents liquides dans un nouveau ty d incinerateur Elf-Heurty). Text in French. Chim Ind., Genie Chim., 103(20), 2617-2618, Dec. 1970.

Highly polluted liquid effluents are destroyed by the new Elf-Heurty type incinerator. In general, highly flammable combustibles are required that are needed in low quantities and are also cheap. Elf system emulsion burners are used for this incinerator. A mixture consisting of liquid dispersion and liquid combustible additive is atomized in the reaction chamber by compressed air. Strict temperature homogeneity is imperative for the whole reaction chamber. The advantages involved in this system lie in low demand for cheap combustibles, the absence of further pollution, the possibility to control furnace atmosphere (oxidizing or reducing), high reliability in operation, and in the utilization of the steam thus generated. The system can also be applied for liquids of high concentration. This incineration method can be used in chemical, petroleum, pharmaceutical, textile and paper-making industry, and in metallurgy. Various modifications can be introduced for treating various liquids.

36657

Morgan, Oliver P.

A SUMMARY OF THE AIR AND WATER POLLUTION ABATEMENT EFFORTS AT WEYERHAEUSER KRAFT MILL AT SPRINGFIELD, OREGON. Washington State Univ., Pulman, Proc. Pacific Northwest Ind. Waste Conf., 10th, Pullman, Wash., 1961, p. 119-128. (May 25-26.)

As part of a program to control odor emissions from a kraft pulp mill, black liquor oxidation has been successful in eliminating sulfides from the liquor, thus preventing stripping of the sulfur compounds in the recovery furnaces and resulting in substantial reductions in odor level from the high stack. A fume-destroying furnace was used to burn relief gases under carefully controlled conditions, oxidizing all odorous sulfur compounds to sulfur dioxide, which has a much lower odor potential. Odorous blow gases were finally controlled by using a vaporsphere to hold the gases and release them at a constant rate to the fume furnace. After some modifications, savings were effected by piping the blow and relief gases to the lime kiln for burning. Some odor control has also been achieved by improved air control in the recovery furnaces and lime kilns. Lime kiln dust losses have been decreased with modifications to the plant scrubber system. The program to control water pollution from the plant is also described in detail.

36658

Collins, T. T., Jr., C. R. Seaborne, and A. W. Anthony, Jr.

REMOVAL OF SALT CAKE FUME FROM SULPHATE RECOVERY FURNACE STACK GASES BY SCRUBBING. Paper Trade J., 124(23):45-49, June 5, 1947. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, New York, Feb. 24-27, 1947.)

Successful development on a pilot plant scale of a new apparatus for scrubbing the fume of sodium salts from pulp mill sulfate or soda furnace stack gases is described. The equipment consists essentially of a venturi through which the waste gases going to the stack pass at high velocity while, at the same time, recirculated water injected into the construction is atomized by the energy of the gases under the extremely turbulent conditions existing in the throat and is then removed in a dry cyclone following the venturi atomizer. Efficiencies of sodium removal of as high as 99% have been attained by a combination consisting of the venturi atomizer followed by the conventional Pease-Anthony Scrubber instead of a cyclone. The combination of a venturi atomizer followed by a dry cyclone, called the venturi-scrubber, gives 85-94% sodium recovery on a pilot plant scale with an estimated power consumption for large scale operation of about 43 kw hour/ton of pulp. Because of the easily attainable high efficiency, low first cost, and simple operation of the venturi-scrubber, the addition of any other equipment to the combination to improve efficiency seems economically unjustifiable. (Author abstract modified)

36659

Collins, T. T., Jr., C. R. Seaborne, and A. W. Anthony, Jr.

USE OF THE VENTURI-SCRUBBER ON SULPHATE RECOVERY FURNACE STACK GASES. Paper Trade J., 126(3):45-49, Jan. 15, 1948. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Alkaline Pulping Committee, Asheville, N. C., Oct. 11, 1947.)

Operating experience with a full-scale venturi scrubber for fume recovery from a kraft pulp mill sulfate recovery furnace rated for 120 tons of daily pulp production is reported. The scrubber is a combination of venturi atomizer followed by a cyclone to remove the atomized liquid. The full-scale unit has a minimum range of efficiency of sodium removal from the furnace gases of 85-90%; actual dust removal efficiency is probably somewhat higher. The overall pressure drops across the venturi atomizer of 16-19 in water are expectedly high, compared with predictions from pilot plant data for 90% efficiency of sodium removal. The sulfur dioxide and hydrogen sulfide content of the stack gases differ, depending on whether the furnace is being operated beyond design capacity; the resulting change in alkalinity of the scrubbing liquor may be considerably important from the corrosion standpoint. Power requirements calculate out to 40 kw hours per ton of pulp, slightly lower than predicted from pilot plant data; further reductions are anticipated from refinements in atomizer design and use of a variable speed fan. Wider applications of the venturi scrubber as an integral part of the kraft recovery furnace are expected with further development.

36760

May, Ben F.

EXPERIENCES IN THE ABATEMENT OF KRAFT MILL ODORS. GULF STATES PAPER CORP. Tappi, 36(8):374-378, Aug. 1953. (Presented at the Technical Association of the Pulp and Paper Industry, Alkaline Pulping Conference, 6th, Mobile, Ala., Nov. 12-14, 1952.)

Use of a direct condenser for digester blow gases was the first success of a Louisiana kraft pulp mill in its efforts since the mid-1920s to abate odor emissions. Chlorine was tried for deodorizing the condenser effluent but was ineffective. Until 1951 all attempts at odor abatement were made with condensers, water spray scrubbers, and improved processing equipment. Trials of odor masking aromatic compounds began in 1951. Efforts to effect a milder and less obnoxious odor by use of these compounds have produced a slight improvement. However, positive conclusions are pending due to extended trials. Future study involving trial of a scrubber system, employing bleach plant waste liquors, is under consideration. Evaluation of results is the most difficult phase in this field of study. A practical, yet accurate, means of odor measurement is needed. The variables involved are quite complicated, including such major ones as process operating efficiency, meteorological conditions, individuals nasal characteristics, and mixing of odors from various sources. (Author abstract modified)

36854

Chamberlain, R. E. and C. E. Cairns

ANALYSIS OF RECOVERY UNIT OPERATION AND CONTROL. Pulp Paper Mag. Can. (Quebec), 73(1):97-104, Jan. 1972. 14 refs. (Presented at the Canadian Pulp and Paper Assoc., Technical Section, Annual Meeting, 57th, Montreal, Canada, Jan. 26-29, 1971.)

Tests were undertaken to evaluate the potential for improved instrumentation of recovery furnace operations and better control of both sulfur gas (hydrogen sulfide and sulfur dioxide) and particulate emissions. The testing considered all major operating variables in the recovery operation, their intermediate effects on furnace operation, and the final operating results. The tests indicated that additional secondary air will increase the oxidation of combustion products without increasing particulate carryover or tube deposition. Despite higher excess air, stack heat losses did not increase because existing temperature simultaneously increased. Change in primary air had no effect on black liquor reduction, except possibly on a short-term basis. Increased secondary air, however, lowered black liquor reduction. Particular attention should be paid to brightness as a measure of char-bed temperature and combustion stability. This measurement is a key to minimum sulfur gas emission and particulate carryover. Air consumption as an index of furnace combustion may provide a control base for increaced stabilization of recovery furnace temperatures. Although this concept is most easily implemented through computer control, modification of air control on an analog basis should reduce variation in furnace combustion.

Establishing furnace production according to combustion and smelting rates suggests trimming the input solids rate to maintain the amount of the material in the furnace constant. (Author summary modified)

37004

West, P. H.

CHEMICAL AND HEAT RECOVERY WITH THE VENTURI SCRUBBER AT THILMANY. Tappi, 38(7):399-402, July 1955. 7 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, 40th, New York, Feb. 21-24, 1955.)

In 1946 a pilot plant venturi scrubber, using water to clean recovery furnace flue gases, was tested at a kraft pulp mill and showed chemical recovery efficiencies of about 90%. A similar full-scale unit, installed in 1947 following the existing 120-ton recovery units, substantiated these findings. Further pilot studies, employing concentrated black liquor instead of water, indicated improvement in heat recovery efficiency over that of conventional kraft recovery systems, while maintaining a high degree of chemical recovery. By mid-1951, because of greatly increased pulp production and the demand for 600 psi steam, a new 250-ton black liquor recovery unit equipped with a black liquor venturi scrubber was purchased. Cost considerations, space requirements, trouble free operation, high chemical recovery efficiency, and maximum heat recovery were considered in the decision to include the venturi scrubber as an integral part of the recovery unit. (Author abstract modified)

37064

Woodward, Eric R.

CHLORINE DIOXIDE FOR ODOR CONTROL. Tappi, 36(5):216-221, May 1953. 21 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Alkaline Pulping Conference, 6th, Mobile, Ala., Nov. 12-14, 1952.)

The use of chlorine dioxide in a limited number of industrial plants which are notorious for the discharge of obnoxious odors has met with success on a commercial scale. The effluent gases contain methyl and ethyl amines, hydrogen sulfide, and mercaptans. As with any other chemical remedy, efficient contact between chlorine dioxide and the offending odors is essential. This involves proper ventilation of buildings where the odors originate, adequate collection and transfer of the odor-bearing medium to the point of treatment, and efficient scrubbing of the odorous compounds before release to the surrounding atmosphere or terrain. Application to kraft mill odors, methods of generating and applying chlorine dioxide, and possible corrosion problems are discussed. (Author abstract modified)

37073

Cromwell, W. E.

OZONE IN AIR POLLUTION ABATEMENT. Ind. Eng. Chem., 51(6):83A-84A, June 1959.

While the chemical mechanism by which ozone combats air pollution is not fully understood, the reaction in most cases appears to be a neutralization of odor formers. Several case histories and the ozone generation equipment utilized are given, describing the use of ozone to treat effluent gases from two New York City sewage treatment plants, to counteract odors from fish processing stack gases, to treat unpleasant kitchen odors, and, experimentally, to treat the effluent stack gases from the sulfate recovery system of a paper pulping mill.

37094

Wright, R. H., M. A. Schoening, and L. W. Shemilt

THE EFFECT OF BLACK LIQUOR FIXATION ON THE RELEASE OF KRAFT ODORS. Tappi, 36(4):180-183, April 1953. 11 refs.

In place of the regular feed of unoxidized black liquor to a kraft mill semipilot oxidation tower, oxidized black liquor was fed continuously to the recovery system for a five-hour period. Throughout the day gases from the recovery system were sampled to determine concentrations of hydrogen sulfide and methyl mercaptan, and liquids, to determine their sodium sulfide concentration. Specific gases and liquids analyzed were evaporator noncondensable gases, evaporator contaminated condensate, evaporator jet-condenser effluent, furnace gases, stack gases, weak black liquor, and strong black liquor. Though H2S in stack gases rose to high values at the end of the day, there was definite overall reduction in the amounts of both H2S and methyl mercaptan liberated by the stack and evaporator. A black liquor fixation system combined with an adsorber of digester gases should provide effective control of kraft odors.

37101

Trobeck, K. G., Walter Lenz, and A. Tirado A.

AIR POLLUTION CONTROL PROCESS IS SWEDISH-MEXICAN DEVELOPMENT. Pulp Paper Int., April 1959:44-48. 2 refs.

At a kraft pulp mill in Mexico, odors liberated from a multiple-effect evaporator are completely eliminated by proper oxidation of black liquor with air. A surface condenser with temperature held at 50-60 C produces contaminated condensate water in smaller batches during digester blows, which makes it easier to destroy odors in such condensate water. A special scrubber promotes good contact between air, noncondensable gases, and contaminated condensate water from the digesters. In this way, all the noxious compounds from the blow-off and relieving of digesters are treated at once in a single apparatus. The result is a definite reduction of air pollution from the gases and a virtual elimination of odors from condensate water. Additional control measures are the detection of odors by a Tritilog and a network of human observers.

37171

Carr, Wayne F.

HYDROCYCLONE. (Assignee not given.) U. S. Pat. 3,568,847. 7p., March 9, 1971. 5 refs. (Appl. Dec. 9, 1968, 3 claims).

Known hydrocylcones for cleaning cellulose suspensions and similar liquid slurries are relatively ineffective in removing foreign particles from mixtures avove 1% fiber consistency. In small separators, large particles are pulled into the higher angular velocity zones of the vortex; in large separators, such particles are forced to the cone wall and frequently held in a stationary orbiting field. By effecting changes in the transition point between the forced and free vortex, an improved cyclone for purifying wood pulp fibers controls the highest centrifugal force zone to achieve the desired particle separation. The cyclone consists of an upper inlet chamber for receiving suspensions and a lower inverted conical vortex chamber for receiving fluid from the upper chamber. A vortex finder in the inlet chamber induces a reversal of the downward flow of the accepted fraction of the suspension from the free vortex path in the lower chamber to an inner forced vortex path. An expandable diaphragm in the vortex finder varies the diameter of the flow path and shifts the transition zone between the free and forced vortex paths. The principles of this invention are equally adaptable to the separation of heavy components from gases. The term fluid includes both liquids and gases, and the term heavier components includes any components, solid or liquid or gas, dispersed in a base medium having a lower specific gravity than the heavier component.

37266

Alley, Forrest C.

REMOVAL OF SULFUR COMPOUNDS FROM GAS STREAMS. (Westvaco Corp., Clemson, S. C.) U. S. Pat. 3,598,521. 3p., Aug. 10, 1971. 6 refs. (Appl. Dec. 11, 1968, 7 claims).

A process is described for removing organic sulfur compounds and hydrogen sulfide from industrial waste gas streams by oxidizing some of the sulfur compounds and adsorbing all the organic sulfur compounds and H2S onto an activated carbon adsorbent. Prior attempts at organic sulfur compound removal were either inefficient or required specially impregnated adsorbents. However, both certain organic sulfur compounds, primarily mercaptans and disulfides, and hydrogen sulfide may be completely and economically removed from waste gas streams by contacting a gas stream of the sulfur compound-containing gas and an oxygen-containing gas with an activated carbonaceous catalytic adsorbent when the initial contact relative humidity is at least 70% at a temperature between 27 and 82C. The adsorbent may be regenerated for reuse and the gas stream passed to the atmosphere free from organic sulfur compounds and H2S. Evolution of malodorous sulfur compounds is by no means limited to the pulping industry. For instance, it is common to remove the odorous sulfur compounds during the production of gasoline.

37494

Shigeta, Yoshihiro

BAD ODOR EMISSION CONTROL MEASURES AND EXAMPLES. (Akushu no haishutsu boshi tai[illegible] [illegible] jitsurei). Text in Japanese. PPM (Japan), 3(1):55-62, Jan. [illegible] refs.

Main sources of bad odors in Japan are chemical engineering, Kraft pulp mills, petroleum refining, chemical fertilizer manufacturing, animals, corpses, fishmeal manufacturing, stockyards, public facilities, garage dumps, excretion treatment plants, and sewage treatment plants. In addition, foundries, paint factories, pharmaceutical factories, canneries, enamel electric wire factories, fish paste manufacturing plants, distilleries, fermentation plants, and rubber factories are sources of bad odors. The main points in bad odor control are the normalization of the human relationship between industries and inhabitants in the area, improvement of manufacturing or treatment processes, and improvement of maintenance and management of these odor creating sources. Various types of countermeasures such as dilution, decomposition of odor elements, and elimination of elements are discussed. Various methods of control such as combustion, catalytic oxidation, adsorption, ozone, acid-alkaline scrubbing, ion exchange resin, electrode, and water scrubbing methods are reviewed.

37554

HOW THE PAPER INDUSTRY IS SOLVING AIR AND WATER PROBLEMS: CHEMICAL RECOVERY MADE POSSIBLE WITH NICKEL STAINLESS STEEL. Nickel Topics, 25(1):4-5, 1972.

The high-speed manufacturing of quality paper depends to a large extent on the strength and corrosion-resistant properties of nickel stainless steel. Its use has now been extended to equipment for reducing air and water pollution which simultaneously recover useful chemicals. Waste chemicals from the ammonium bisulfite pulping process are concentrated in a nickel stainless steel evaporator and are then burned in a recovery furnace to generate process steam and recover sulfur dioxide gas from the furnace flue gases. All equipment in contact with SO2 at temperatures below the dew point, or used in handling aqueous SO2 solutions, is made of Type 316L or Type 317 nickel stainless steel. In addition, these and other types of nickel stainless steel are used for water recycling systems, screens for chip washing, and washers for pulp from digesters and bleaching operations.

37677

Horntvedt, Einar

OPERATING EXPERIENCES AND ECONOMIC ASPECTS OF THE SCA-BILLERUD (RECOVERY) PROCESS. (Driftserfarenheter och ekonomiska aspekter pa SCA-Billerudprocessen). Text in Swedish. Norsk Skogind. (Norway), 25(5):131-134, May 1971.

In the SCA-Billerud chemical and heat recovery process for sodium-based SSL, diluted SSL (from washed pulp) is evaporated to 50-55% dry solids, then sprayed in finely divided droplets into a pyrolysis reactor where the atomized particles are mixed rapidly and intensely with hot stack gases. Because of the low proportion of oxygen in the flue gas, a reducing atmosphere prevails in the reactor, resulting in rapid production of combustible gas (in which most of the sulfur is in the form of hydrogen sulfide) plus a fine dust (large sodium carbonate), plus organically derived carbon. In the subsequent degassing chamber, exothermal heat is given off (which is used for steam generation) before the dust is separated from the gas phase. The major portion of the steam in the gases is condensed to increase the fuel value. The sodium carbonate is leached from the dust, and the residual carbon is recycled to the pyrolysis reactor. The gases are burned in a furnace which converts the H2S to sulfur dioxide; the latter is absorbed by the leached sodium carbonate, and the resulting cooking liquor is recycled to the digester. Thhe size of the recovery plant depends mainly on the dry solids content of the SSL. This in turn depends on mill capacity, pulp yield, chemical charge, and degree of liquor recovery. The chemical consumption varies not only between different pulping processes but also between different sulfite mills using the same process. Investment costs and profitability of recovery vary inversely with pulp yield.

38194

Lardieri, N. J.

CONTROL OF AIR-BORNE EMISSIONS FROM SULFATE PULPING. Chem. Eng. Progr. Symp. Ser., 57(35):68-73, 1961. 5 refs.

Control measures for airborne effluents from kraft cooking and chemical recovery processes are described. At the great majority of kraft pulp mills, the high efficiency of electrostatic precipitators and venturi evaporator-scrubbers is adequate for control of particulates from the recovery furnace or lime kiln. Where it has been necessary to discharge a gas even lower in particulate matter than that produced by the precipitator, several mills have installed wet scrubbers in series with the basic collection unit. These scrubbers are generally the low head loss, fog type. Black liquor oxidation systems, foaming or nonfoaming, are used to reduce the quantities of odorous sulfur gases emitted from pulping and recovery operations. In some existing black liquor oxidation systems, abatement of odors from the digestion phase of pulping is also accomplished as digester relief gases are introduced with air into the oxidation tower and partially oxidized in this manner. Noncondensible digester relief gases and blow gases are collected in a vaporsphere, passed through a rock-packed scrubber, and then burned in a lime kiln. Alternatively the gases can be passed from the vaporsphere to a chlorination washer for complete oxidation of odorous sulfur compounds.

38210

Heaney, J. P. and L. Doughty

OPTIMAL ATMOSPHERIC EMISSION CONTROL IN THE WOOD PULP INDUSTRY. Atmos. Environ., 6(2):93-102, Feb. 1972. 10 refs.

A mathematical programming model was formulated to determine the optimal atmospheric emission control alternatives for the pulp industry. Generalized multi-path programs were developed showing the emission sources, the unit emissions from these sources, and the available control alternatives. Using these diagrams it is possible to depict a given mill by selecting the appropriate flow paths. Formulation of the optimization model as a mixed integer-linear programming problem is presented. Then the results of a sample analysis using the model are described. A procedure is presented for determining the net cost of particulate emission standards as well as a sensitivity analysis of the impact on the optimal solution of varying the value of recovered chemicals. (Author abstract)

38235

Frost, H. J.

ELIMINATION OF WASTE PRODUCTS BY INCINERATION. (Entsorgung durch Verbrennung). Text in German. Preprint. Badische Anilin- and Soda-Fabrik A. G., Ludwigshafen (West Germany), 5p., June 24, 1971.

In the chemical industry, waste products are mostly removed by incineration where emissions must be combatted. Waste gas with low fuel concentration (below the lower explosion point) can be catalytically or thermally afterburned. Catalytic afterburning takes place on oxide or precious metal catalysts both of which are soon contaminated and become ineffective. Thermal afterburning takes place at higher temperatures. Auxiliary fuel is used to achieve higher temperatures. For combustion of odorous substances, muffle furnaces are used. Incineration plants for substances which cause considerable pollutant emission can be operated only in connection with absorption plants. For incinerating chlorine-containing byproducts in vinylchloride and propylene oxide manufacture as well as other halogenated hydrocarbons, several methods have been developed (Uhde, UCC, Yawata, and Oxychlo5ration) where hydrochloric acid, hydrogen chloride, and chlorine are obtained. A special burner construction is necessary to guarantee soot-free combustion. The combustion of sulfite waste lyes from the cellulose industry has been successfully solved. The magnesium oxide is separated by means of cyclones. As aqueous solution, it is then used for the desulfurization of waste gases. As much as 100,000 cu m gas/hr may leave the stacks of refineries in case of faults or also at the beginning or the end of an operation. These gases must be burned in a flare. It is of importance that such flares have a reliable ignition system.

38444

Clement, John L.

GASEOUS SULFUR DIOXIDE ABSORPTION SYSTEM. (Babcock and Wilcox Co., New York) U. S. Pat. 3,615,165. 7p., Oct. 26, 1971. 2 refs. (Appl. Dec. 10, 1968, 2 claims).

Magnesium base chemicals in liquid form have proven highly effective in removing sulfur dioxide gases from the products of combustion in the incineration of residual liquors. When used in the chemical recovery system of a pulp and paper installation, both the magnesium compounds and the SO2 absorbed in the magnesium may be reused in the chemical process. The SO2 absorption from flue gases may be applied to the products of combustion resulting from flue gases may be applied to the products of combustion resulting from both the incineration of pulp residual liquors and the combustion of other sulfur-containing fuels. In the latter case, the absorbed SO2 may be separately processed for reclamation of the sulfur components in a useable form. A system is described for the absorption of SO2 by passing the combustion gases in series through a plurality of direct contact zones. The absorption liquid is comprised of a solution of magnesium and sulfur which is sprayed into the gas, and the makeup water in the solution is selectively added into the last zone for optimum SO2 absorption efficiency of the entire system. (Author abstract modified)

38565

Saito, Hirotaro and Shigeo Kamio

SODA RECOVERY BOILER EXHAUST GAS PURIFICATION METHOD. (Soda kaishuyo boira no hai-gasu jokaho). Text in Japanese. (Honshu Paper Mfg. Co., Ltd., Tokyo (Japan)) Japan. Pat. Sho 46-40482. 3p., Nov. 30, 1971. 1 ref. (Appl. April 28, 1967, 1 claim).

This is a method of eliminating the remaining mirabilite dust and sulfur oxides from the exhaust gas of a Kraft Pulp mill soda recovery boiler, which has already been treated by an electrostatic precipitator. Even with the high rate of collection of 93 to 95% by an electrostatic precipitator, close to 750 tons of mirabilite dust and toxic gas are emitted daily from every pulp mill of 430 ton/day capacity. By this method, the exhaust gas from the recovery boiler is led to an electrostatic precipitator and 93% to 95% of dust is eliminated. The treated gas is then led to the invented apparatus. This is a large, cylindrical atomizer, in which the black liquor from a tank is jet sprayed from the top through a rotation disk and a ring shower. At the bottom of the chamber lies a funnel shaped receptacle with a number of slits with baffle boards. The remaining dust and sulfur oxides in the exhaust gas are completely absorbed by atomized black liquor and go out through the slits. The sulfur dioxide absorbed in the black liquor can be recovered as sodium sulfite.

38569

Toro, R. F., J. Magder, and A. T. Goding

REMOVAL OF SULFUR DIOXIDE FROM WASTE GASES BY REDUCTION TO ELEMENTAL SULFUR. (FINAL REPORT). Princeton Chemical Research Intc., N. J.f National Air Pollution Control Administration Contract PH 88-68-48, 295p., July 30, 1969. 70 refs. NTIS: PB 200071

Sulfur dioxide removal from waste gases by the modified Claus process is examined with respect to the technology, operating conditions, catalyst atctivitey,,;, effects of flue gas composition hydrogen sulfide generation, reactor and process design, and investment and operating costs. The SO2 is catalytically reduced in one step to elemental sulfur, using H2S which is generated by the one step reaction of elemental sulfur with natural gas and water. The reduction and sulfur collection are performed near normal flue gas temperature. Concurrent removal of nitrogen oxides is thermodynamically possible through reduction to nitrogen by reaction with H2S. The recovery of elemental sulfur as 5a by-product and low investment and operating costs are advantages with respect to economics. The process may be adapted for use in fossil fuel power plants, metallurgical roasting plants, oil refinerites, sulfuric acid plants, Claus sulfur plants, ane pulp and paper manufacturing.

38697

Harkness, A. C. and F. E. Murray

OXIDATION OF METHYL MERCAPTAN WITH MOLECULAR OXYGEN IN AQUEOUS SOLUTION. Atmos. Environ., 4(4):417-424, July 1970. 6 refs.

Oxidation rates, reaction mechanisms, and catalytic activity involved in the oxidation of methyl mercaptan with molecular oxygen in an aqueous solution were investigated to provide data on which to base control methods for air pollution by kraft pulp mills. Methyl mercaptan was readily oxidized in an alkaline solution in the presence of metal ion catalysts. Oxidation rates in the absence of catalytic materials were extremely slow. The products of oxidation at 30 C in a strongly alkaline solution were dimethyl disulfide and hydrogen peroxide. The chemical reactions were first order with respect to both oxygen and mercaptan concentration, although the oxidation proceeded mostly in the intermediate regime between kinetic and diffusion control. The order of decreasing catalytic activity among the metal salts studied was cobalt chloride, copper sulfate, nickel formate, ferric sulfate, zinc sulfate, and silver nitrate. (Author conclusions modified)

38723

Llewellyn, William F.

SUCCESS IN KRAFT MILL ODOUR EMISSION CONTROL - A CASE HISTORY. Int. Paper. Board Ind., 14(6):22-24, June 1971. (Presented at the Technical association of the Pulp and Paper Industry, Water and Air Conference, 8th.)

Field experience with kraft mill siting and odor control is reviewed. The major sources and control equipment included a recovery boiler electrostatic precipitator, a lime kiln Venturi scrubber, a dissolving tank vent equipped with a suitable scrubber, and a black liquor oxidation system. The digester was equipped with a condenser and non-condensible gases are conveyed to the lime kiln for thermal oxidation. Any reduced sulfur compounds still released in the evaporators after black liquor oxidation are incinerated in the lime kiln after removal of water vapor with a condenser. Off-gases from the black liquor oxidation system and the lime kiln scrubber are discharged with the recovery boiler flue gases through the main stack. Brown stock and chlorine stage hood exhausts are discharged through suitable scrubbers.

39205

Meinhold, Ted F.

THILMANY RECLAIMS 90% OF CHEMICALS FROM FLUE GAS. Chem. Process. (Chicago), 19(8):14-15, March 1956.

When pulp production at a pulp and paper plant was boosted to 165 tons per day, a 250-ton, 600-psi, Babcock and Wilcox recovery unit equipped with a black liquor venturi scrubber was installed to keep pace with the added production. The venturi scrubber on the new unit used black liquor for scrubbing, making it possible to clean the flue gases, lower their temperature, and further concentrate the black liquor at the same time. Operation of the scrubber is described. The flue gas leaving the scrubber has a concentration of 0.4 grains dust per cu ft, compared with an entrance concentration of 3.9 grains, resulting in a chemical recovery efficiency of 90%.

39206

Roberts, L. M., C. E. Beaver, and W. H. Blessing

OPERATING EXPERIENCES WITH COTTRELL PRECIPITATORS ON SULPHATE RECOVERY FURNACE GASES. Paper Trade J., 127(18):45-49, Oct. 28, 1948. (Presented at the Alkaline Pulping Committee, Technical Association of the Pulp and Paper Industry, Asheville, N. C., Oct. 11, 1947.)

Operating data and plant experience with Cottrell precipitators for recovery of sodium compounds from sulfate mill recovery furnace gases are presented. The data, which apply to 38 precipitators in 16 installations, cover pulp tonnage, operating temperatures, amount of precipitate, dust analyses, operating availability, and maintenance and labor costs (1968). In general, the precipitators show recoveries of 88-145 lbs/ton of pulp, the average being 118 lbs. Based on the average rate and a precipitator availability of 95%, the yearly return from a 250-ton mill operating 350 days/yr would be 4900 tons.

39226

Galeano, Sergio F., Don C. Kahn, and Reynold A. Mack

AIR POLLUTION - FREE OPERATION OF A NSSC RECOVERY FURNACE. Technical Assoc. of the Pulp and Paper Industry, New York, Tappi Engineering Conf., 25th, Proc., Denver, Colo., 1970, p. 97-105. 11 refs. (Oct. 27, Paper 4-2.)

Differences between the spent liquors from neutral sulfite semi-chemical pulping and kraft pulping are cited, and the operation of a neutral sulfite semi-chemical pulping recovery furnace for air pollution-free operation is described. It was possible to modify the operation of the furnace by applying fundamental principles of thermodynamics and full knowledge of liquor characteristics. Proper instrumentation and control are required for the operation of the furnace. Proper turbulence in the secondary zone is an essential factor, and a proper sodium/sulfur ratio must exist in the liquor for a desired level of sulfur dioxide emissions. (Author conclusions modified)

39256

Dexter, Gregory M.

ELIMINATION OF KRAFT MILL ODORS. Paper Trade J., 129(20):78-81, Nov. 1949.

The sources and strengths of kraft mill odors the use of scrubbers in odor control are discussed. An oxidation tower to be used ahead of the multiple-effect evaporator oxidizes volatile sulfur compounds. An Inka tower could also be used after the usual precipitator to collect any chemicals, organic sulfur compounds, and sulfur dioxide remaining in the waste gases and thus reduce odors from the recovery furnace by 90% or more. Dust or fumes in the stack gases may also be recovered in the Inka tower. The recovery furnace should be somewhat larger than the rated capacity of the mill since lower production costs are usually sought by exceeding the designed capacity of the furnace. The direct-contact evaporators are a source of the odors in the stack gases. One approach to odor removal is to replace the direct-contact evaporator with a larger-capacity multiple-effect evaporator in order to increase the amount of solids in the black liquor from 55 to 65%. Elimination of the direct-contact evaporator will reduce the moisture content of the gases going to the precipitator below the desirable 19% of the total volume. This condition can be corrected by blowing steam at about 350 F or higher into the waste gases. A 98%-efficient electrostatic precipitator should replace 90% precipitators. The greater efficiency is justified by increased chemical recovery and reduction of odor. Catalysts and chimney heights are also discussed.

39282

Moncrieff, R. W.

THE COUNTERACTION OF ODORS. Chem. Can., vol. 11:66, 68, 70, 72, Sept. 1959. 16 refs.

In the past, odor counteraction was applied only to products. Today the objectional effluent odor from herring reduction factories pulp mills, sewage plants, and many other industrial scenes are counteracted by spraying suitable chemicals into the exhaust gases at chosen points. Effective counteractants are known for most classes of malodors likely to be encountered in industry. Work still in progress shows that counteraction can be achieved with many pairs of odorants. For instance, mixtures of butyric acid and oil of juniper, as well as mixtures of pyridine and oil of wintergreen, can be adjusted so that neither of the two components can be identified. An olfactometer can be used to mix odors and regulate their amount.

39291

Blue, Jerry D. and William F. Lleweilyn

HALSEY RECOVERY SYSTEM REPORT. FIRST YEAR OPERATION FOR ODOR CONTROL. Technical Assoc. of the Pulp and Paper Industry, New York, Tappi Eng. Conf., 25th, Proc., Denver, Colo., 1970, p. 395- 405. 3 refs. (Oct. 28, Paper 10-3.)

First-year operating experience with a kraft pulp and paper mill odor control recovery system is described, and equipment and system concepts and designs are reviewed. Performance data show that a recovery boiler design eliminating direct contact evaporation and arranged to fire un-oxidized black liquor supplied directly from the multiple effect evaporator can meet or exceed predicted performance and odor reduction requirements. Electrostatic precipitators and incineration are also indicated. Minor problems associated with the new system are discussed. (Author abstract modified)

39433

Tremaine, Breckenridge K.

RECENT DEVELOPMENTS IN MASKING SULPHATE PULP MILL MALODORS. Tappi, 37(8):141A-143A, Aug. 1954. 11 refs.

While masking agents are not the complete answer toward overcoming an air pollution odor nuisance and are not always 100% effective, they are a tool which when properly applied will help to change the perception of the malodors from a sulfate pulp mill process. The use of masking agents do not incur major capital expenditures. Improved odor control is possible when a dual treatment is established which consists of applying the masking agent to the digester and also to the heat recovery system. Comments of mill observers not using a dual treatment are included. The study of local weather conditions is also an important phase of an odor abatement program. Knowledge of temperatures, humidity conditions, inversion levels, and turbulence is of great importance to establish dispersion characteristics.

39498

Bernstein, R. H.

THE BASIC CHEMISTRY OF FLUE GAS DESULFURIZATION. Technical Assoc. of the Pulp and Paper Industry, New York, Tappi Eng. Conf., 25th, Proc., Denver, Colo., 1970, p. 85-95. 14 refs. (Oct. 27, Paper 4-1.)

The basic chemical equations representing the several mechanisms by which sulfur dioxide can be removed from power plant flue gases are reviewed. The goal of desulfurization has attracted a multitude of process schemes which in turn represent such diverse fundamentals as catalysis, adsorption, chemical reaction, solubility in water, or a combination of these. One system involves removing fly ash and catalytically oxidizing SO2 in the flue gas to sulfur trioxide. The SO3 reacts with water vapor in the flue gas and is condensed as sulfuric acid at an average concentration of 80%. Dry dolomite injection/wet scrubbing, magnesium oxide scrubbing, absorption in potassium sulfite solution, the reaction of sodium hydroxide with SO2, dry limestone, and black liquor scrubbing are described. The problem of desulfurizing flue gases is compared with utilizing or recovering the SO2 present in gas streams of pulping processes. (Author bstract modified) 0

39575

Wilson, Albert W.

PORT TOWNSEND RECOVERY BOILER IS ALMOST ODORFREE. Pulp Paper, no. 4:78-82, April 1971.

The design and operation of a new recovery boiler installed at a kraft pulping plant are reviewed. Improved odor control is effected by preventing any direct contact of black liquor with outgoing flue gases. Formerly, the gases went to the cascade evaporators directly from the boiler; the odor gases released by evaporation of black liquor are now burned in the furnace. The problems involved in the construction, planning, installation, and running of the boiler are reviewed.

39596

Overend, Miles

HILL STACK DISPERSAL TO BEAT INVERSIONS. Water Pollution Control (Toronto), 110(4):76, 78, April 1972.

Weyerhaeuser Canada Ltd. is building a new pulp mill on the banks of the Thompson River in Kamloops, British Columbia, at a cost of about $110 million, of which more than $22 million will be spent on direct and indirect pollution control measures. Incorporated in the far-reaching environmental protection plan will be a new super stack up the side of a mountain, costing $6,465,000, which is expected to lead flue emissions above the inversion level. The biggest item in the water protection department will be the new 75-acre effluent lagoon, which will provide a five-day retention period for mill effluent before it is discharged. Included in the water treatment facilities will be two settling ponds, a clarifiers, and a large emergency dump pond, where spills can be released. Other water protection devices are mentioned, and provision for the high level stack discharge is described.

39773

Morgan, J. P. and F. E. Murray

A COMPARISON OF AIR AND STEAM STRIPPING AS METHODS TO REDUCE KRAFT PULP MILL ODOUR AND TOXICITY FROM CONTAMINATED CONDENSATE. Pulp Paper Mag. Can. (Quebec), 73(5):62-66, May 1972. 6 refs. (Presented at the Canadian Pulp and Paper Association, Technical Section, Air and Stream Improvement Conference, 6th, Quebec, Ontario, April 13-15, 1971.)

The relative ease of removal of methyl mercaptan, methyl sulfide, methyl disulfide, and terpineol is illustrated for an air stripper operating with air flow-rates such that the gases from the tower are well below the lower explosive limit. A theoretical comparison of air and steam stripping, combined with thermal oxidation of malodorous noncondensables is made for a 750 t/day kraft pulp mill. Air stripping, when combined with burning, is a less complicated system and has significantly lower operating costs. Steam stripping combined with burning would be recommended, should recovery of turpentine be worthwhile. Recovery of other by-products by steam stripping, such as methanol, could be feasible in a few cases. (Author abstract)

39801

Meuly, Walter C. and Breckinridge K. Tremanine

ABATEMENT OF SULPHATE MILL MALODORS BY ODOR MASKING AGENTS. Tappi, 36(4):154-161, April 1953. 18 refs. (Presented at the Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, 6th, Mobile, Ala., Nov. 12-14, 1952.)

A method of masking the principal airborne kraft mill malodors (volatile sulfur compounds) by means of odor-masking agents introduced into the digesters and released simultaneously with the malodors throughout the kraft process is described. The modified kraft odors are less intense and less offensive. The simplicity of application, masking power at very high dilutions, and pervasiveness are discussed. Laboratory studies and extensive field tests are also described. A rational explanation of odor masking is attempted, based on semiquantitative odorimetric measurements of odor quantities and degree of masking. For this purpose, the values of scent unit, scent value, gram scent value, mask unit, mask value, and masking ratio are introduced and defined. These values and measurements permit an estimate of kraft mill odors and of quantities of masking agents required. Laboratory results have been supported by literature and field data. (Author abstract modified)

39888

WE DON T HAVE ALL THE ANSWERS. Air Repair, 2(2):52-58, Nov. 1952.

Efforts by industry to reduce air pollution in Harris County, Tex., especially in the Ship Channel area, are cited by industry representatives at a public hearing in Houston in excerpts from their testimony. Statements by local officials are also given. Specific problems discussed include odors and fly ash from a pulp mill, dust and odors from a chemical plant, dusts and smoke from a fertilizer plant, odors from an alkali plant, and refinery emissions.

40098

Beaver, C. E.

COTTRELL ELECTRICAL PRECIPITATION EQUIPMENT. SOME TECHNICAL AND ENGINEERING FEATURES, RECENT DEVELOPMENTS AND APPLICATION IN THE CHEMICAL FIELD. Trans. Am. Inst. Chem. Engrs., vol. 42:251-261, 1946. (Presented at the American Institute of Chemical Engineers, Chicago, Ill., Dec. 16-19, 1945.)

The basic technical and engineering features of a Cottrell electrical precipitation installation are described including the equipment required, various types of precipitators for specific applications, and design factors. The variables influencing the rate of precipitation or efficiency of removal are reviewed, particularly gas velocity, time of treatment, current flow, and surface conductivity of the suspended particles. Recent improvements in design, construction, and operation are outlined. Cottrell equipment is used extensively in the chemical and metallurgical industries, often to recover a marketable by-product, to clean a gas stream for subsequent uses, or to control an air pollution problem. Recent applications in the phosphorous, pulp and paper, carbon black, and petroleum industries [illegible] (Author abstract modified)

40107

KILLING ODORS BY CHEMICAL REACTION. Chem. Week, 89(10):125-126, Sept. 9, 1961. 2 refs.

Chemical process plants with sulfide odor problems may be able to kill these smells by catalytic oxidation in open air. An oxidation technique reportedly successful for hydrogen sulfide, methyl mercaptan, and other alkyl mercaptans contained in stack gases from a kraft sulfate paper mill and an oil refinery is discussed. The key to the method is a product called Alaxol SRM, which is said to be a mixture of inorganic and organic compounds. When added to stack gases it speeds up the oxidation of reduced sulfur compounds. Eliminating odor by chemical reaction instead of counteraction. Evaluation of the technique, costs and concentrations, and masking and counteragents are considered.

40114

Hartsuch, Paul J.

PAPER INDUSTRY IMPROVING THE ENVIRONMENT. Graphic Arts Monthly, 43(5):48-51, May 1971.

In the papermaking process, only about half the weight of the original wood becomes saleable paper, while disposal of the residual - bark, clay, wood sugars, starches, and other materials - creates severe air and water pollution. Pulp-making operations and not the paper mills are responsible for almost all the air pollution caused by the paper industry, paper mill stack plumes are almost completely water vapor, while pulp mills produce solid and gaseous effluents, including odorous sulfur compounds. Electrostatic precipitators, scrubbers, and other types of equipment are being installed in kraft mills to collect particulates, and low-odor recovery boilers are contributing to reduced hydrogen sulfide emissions. The scope and costs of industry water and air pollution research and control programs are reviewed, particularly for the recycling of consumer-produced waste paper, part of an overall forest conservation program0 that also includes reforestation, fire control, and disease and pest control. Systems for recovering paper pulp from solid wastes and from process by-products such as sawdust are being investigated.

40366

Fernandes, J. H.

CONTROLLING COMBUSTION-CAUSED AIR POLLUTION. (Bestrijding van de luchtvervuiling afkomstig van verbrandingsbronnen). Text in Dutch. Polytech. Tijdschr., Ed. Procestechniek (The Hague), 26(15):176-190, March 1972. 19 refs. (Presented at Rotterdam, Netherlands May 25-26, 1971.)

Various systems and equipment applied for air pollution control in the United States are reviewed. Improvements in technology, waste gas cleaning, and applying optimum emission conditions are the three basic means for controlling air pollution. Examples for minimizing pollution by technological improvements are given (steam boiler, standard boiler equipped with Loddby hearth, Air Contact Evaporator system for cellulose industry, and flue gas cleaning system for incinerators). Different types and principles of dust separators are described (spiral and rotary cyclones, scrubbers, venturi scrubbers, electrostatic filters, and tissue filters). Electrostatic filters, requiring direct voltages of 15,000 to 100,000 volts, have efficiencies over 99% for a wide range of particle sizes. The efficiency of tissue filters lies in about the same order of magnitude. Wet or dry absorption, catalytic oxidation, the use of low-sulfur fuels, fuel additives, or low excess air are the most important means of abating sulfur dioxide emissions. Dry absorption of sulfur dioxide occurs in the alkalized alumina process at 330 C, while the catalytic oxidation to sulfur trioxide at 500 C is followed by cooling in economizer and in contact with cool sulfuric acid, respectively. The sulfuric acid obtained is of 80% concentration, and an efficiency of 90% is reached. A process developed by Combustion Engineering is described. For the control of nitrogen oxides, low excess air of 1-5% is best. The problem of creating optimum emission conditions to minimize pollutant concentrations can be effectively solved by applying high stacks and high emissions speeds.

40958

Brink, David L. and Jerome F. Thomas

METHOD AND APPARATUS FOR PREVENTING FORMATION OF ATMOSPHERIC POLLUTANTS IN THE COMBUSTION OF ORGANIC MATERIAL. (California Univ., Berkeley) U. S. Pat. 3,639,111. 6p., Feb. 1, 1972. 11 refs. (Appl. Jan. 30, 1969, 12 claims).

Organic material, such as kraft black liquor, organic fuels, garbage, and organic wastes, can be destructively distilled and pyrolyzed at an elevated temperature, for a time sufficient to break down the material to noncombustible solids and to a stable gaseous clean burning fuel. The temperature is maintained to preclude recombination of intermediate products formed during the pyrolysis and which would otherwise pollute the atmosphere. A controlled amount of oxygen is continuously introduced during the cracking to provide energy by exothermic oxidative reactions but the oxygen is insufficient to effect stoichiometric (complete) combustion. (Author abstract modified)

41474

Morgan, Oliver P.

CONTROL OF EMISSIONS FROM THE WEYERHAEUSER COMPANY KRAFT MILL AT SPRINGFIELD, OREGON. Preprint, American Chemical Society, Washington, D. C., 15p., 1971. 4 refs. (Presented at the American Chemical Society, Northwest Regional Meeting, Annual, 26th, Bozeman, Mont., June 16-18, 1971.)

By control of three factors, a 98% or better control of the kraft mill odor problem can be obtained. The factors are: odor release from the Cascade evaporator, release of non-condensible gases, and odor release from the recovery furnace. The accomplishments at the Springfield mill in controlling these factors are discussed. A furnace which does away with the direct contact evaporator, the greatest potential source of hydrogen sulfide in the recovery system, was put into production recently. Air is heated by the hot flue gases through an air heat exchanger. The hot air performs the final black liquor evaporation in a contact evaporator and is then admitted to the furnace as combustion air. Collection of non- condensible blow gases was a great challenge since they came with a rush over a period of 5-10 minutes while the digester was blowing, then stopped until the next one blew. The gases had to be contained, with no air dilution, because they are also explosive. A design similar to those used in the petroleum industry to prevent escape of volatile vapors from storage tanks was chosen. For collecting blow gas, a 27 ft diameter steel sphere was designed, to hold up to 10,000 cu ft of gas. Inside the sphere, a gas-tight flexible diaphragm was designed to rise with the rush of gas coming into the sphere at the bottom, and then fall slowly as the gas was drawn out at a constant and controlled rate to the fume destroying furnace. Operating controls which contribute to reduction of odor in the kraft pulping process include addition of about 2.5% excess oxygen, careful control of the percentage of secondary air and the droplet size of the black liquor entering the furnace, and operation in the lower range of sulfidity which will give adequate pulp quality.

41603

Clement, J. L. and J. S. Elliott

NEW DESIGN FOR A KRAFT RECOVERY BOILER FOR THE ELIMINATION OF ODOR. (Un nuevo diseno de caldera de recuperacion kraft elimina olor desagradable). Text in Spanish. Dyna (Madrid), 46(7):339- 343, July 1971. 4 refs.

The new Kraft recovery boiler designed by Babcock and Wilcox, which lacks the direct contact evaporator which constitutes the chief odor emission source, provides complete combustion of the black liquor and prevents hydrogen sulfide and organic sulfur derivative emissions. Complete combustion of the latter occurs in the upper portion of the furnace by means of intensive air supply at the second and third air inlets. An enlarged heat transfer surface provides the cooling of the emissions leaving the stack. The new Kraft recovery furnace emits combustion gases containing less than 1 ppm of H2S and sulfur dioxide as the main sulfur containing pollutant. Included is a graph indicating that minimum SO2 levels in the stack gas which can be achieved when the sodium/sufur ratio in the black liquor is above 3.6. Stack height and further developments in the SO2 absorption equipment of the furnace will provide other means to control the emissions of SO2.

42246

Walther, James E. and Herman R. Amberg

THE ROLE OF THE DIRECT CONTACT EVAPORATOR IN CONTROLLING KRAFT RECOVERY FURNACE EMISSIONS. Can. Pulp Paper Assn., Tech. Sec., 72(10):T305-T307, Oct. 1971. 10 refs. (Presented at the Canadian Pulp and Paper Association Technical Section, Annual Meeting, 57th, Montreal, Quebec, Jan. 26-29, 1971, Paper T305.)

Total reduced sulfur and sulfur dioxide emissions from several conventional recovery furnaces using direct contact evaporation (DCE) and a newer-designed furnace which does not have a DCE were studied. The DCE was not a source of sulfur when the black liquor sodium sulfide content was less than 0.5 g/l and the pH at 12 or higher. Average recovery furnace sulfur emissions were less than 5 ppm, and average SO2 concentrations ranged from 150 to 680 ppm. The DCE can remove about 75% of the SO2 emission and up to 50% of the furnace sulfur emission, when the total reduced sulfur concentration exceeds 5 ppm. The DCE removes 20% or more of the particulate load to the precipitator, and removes sodium trioxide and other acidic components from the furnace.

42319

Turk, Amos, Robert C. Haring, and Robert W. Okey

ODOR CONTROL TECHNOLOGY. Environ. Sci. Technol., 6(7):602-607, July 1972. 5 refs.

Odor control devices or systems are essentially the same as those controlling other types of air pollution -- fume incineration, wet scrubbing absorption, process change, or product elimination. Chemical oxidation and masking primarily are employed for odor control. The low olfactory threshold of many compounds and the difficulty in measuring their residual concentrations make subjective techniques necessary to determine the effectiveness of odor correction systems. The selection of judges for odor discrimination tests is considered. An almost standard method of controlling odorous pollutants is dispersing them to a concentration level at which they are no longer detected, or if detected, are no longer offensive. High temperature air oxidation, direct flame oxidation, and catalytic oxidation are indicated. Activated carbon and silica gel are common adsorbents which are extremely useful for concentrating odorants to facilitate recovery. Liquid scrubbing, condensation, and chemical reactions may also be used to destroy odors. Potassium permanganate, the most powerful of the oxidizing agents available, can be used in three ways: as a solution in a scrubbing tower, impregnating a water-adsorbing inorganic substance with a solution, and spreading the permanganate as a dry mixture over the odor producing area. Ozone and chlorine are also effective oxidizing agents. Applications of odor control methods are discussed for the paper industry, petroleum refineries, phthalic anhydride plants, the fertilizer industry, roofing, adhesives, foundries, pesticides, pharmaceuticals, and textile manufacturing.

42431

Williamson, D. F. and J. Klinovich

ENGINEERING TO SAFEGUARD OUR ENVIRONMENT. Can. Pulp Paper Assn., Tech. Sec., Tech. Paper, no. 1:D25-D27, 1971. (Presented at the Annual Meeting, 57th, Jan. 26-29, 1971.)

Accomplishments in the area of emission reductions by members of the pulp and paper industry are described. Particulate emissions levels from the recovery boiler, lime kiln, and smelt tank vent and total reduced sulfur emission from the recovery boiler at the new American Can Company mill at Halsey, Oregon are compared with Oregon state regulation for 1972 and 1975. Achievements at other mills in effluent color reduction and sulfite recovery are described. Typical kraft mill odorous gas emission reduction from black liquor oxidation, gas scrubbing, turpentine recovery systems, and vaporshere processes are presented. Some areas for possible research and improvement include: reduction of gland water to process pumps, use of mechanical seals on specific applications, stripping of contaminated condensate with flash process steam, recycling of primary effluent treatment sludge, and reduction of pulp and paper effluent color.

42893

Foss, Eyvind and Sven-Erik Jonsson

PULP MILLS DON T HAVE TO SMELL. Tek. Tidskr., 102(11):64-66, 70, 72, June 5, 1972. 4 refs.

Processes for reducing malodorous condensates and gases from kraft pulp mills are discussed. A process involving the collection and combustion of gases containing sulfur compounds and methanol, purification in a stripping column, and burning of the gases vented from the column is described. Alternative solutions for odor elimination, including incineration in lime kilns, muffle furnaces, batch digesters, absorption, and the use of scrubbers, are reviewed. Suggestions are given for more effective BOD reduction and condensate treatment. Costs of the equipment are considered.

42908

Gonzalez, Virgilio

THE ABSORPTION OF MERCAPTANS WITH WHITE LIQUOR IN A KRAFT PULP MILL. International Union of Air Pollution Prevention Associations, Proc. Int. Clean Air Congr., 2nd, Washington, D. C., 1970, p. 864-867. (Dec. 6-11, Paper EN 34A.)

The scrubbing of gases containing mercaptans, generated in a kraft pulp mill, with a white liquor, is a desirable process from the standpoint of odor control improvement. The process is also beneficial to the pulp quality and yield. In a conventional mill using batch digesters, its adoption to treat digester residue can lead to a 30% lowering of the odor index. The process can be used to treat other mercaptan-containing effluents such as evaporator noncondensibles. Experimental and developmental work on the white liquor scrubbing process is described. The liquor consists of sodium hydroxide and sodium sulfide. The effectiveness of this treatment is tested by an odor panel. (Author conclusions modified)

43396

Knudson, James C.

AIR POLLUTION CONTROLS TO MEET WASHINGTON STATE KRAFT MILL STANDARDS. Preprint, Air Pollution Control Assoc., Pacific Northwest International Section, 40p., 1970. 10 refs. (Presented at the Air Pollution Control Association, Pacific Northwest International Section, Annual Meeting, Spokane, Washington, 1970.)

A 1969 regulation passed by the State Air Pollution Control Board required kraft mills to monitor malodorous and particulate emis- sions, and to report all monitoring results on a monthly basis. Detailed compliance schedules for controlling air pollution were adopted early in 1970. The companies are required to submit quarterly progress reports concerning their compliance schedules. The programs submitted show that kraft mills in Washington have adopted the following control methods: TRS (total reduced sulfur) standards will be met by the installation of new furnaces and/or black liquor oxidation (weak and strong), and/or by reduced sulfur scrubbing; particulate standards will be met by the installation of new electrostatic precipitators on recovery furnaces, venturi scrubbers on lime kilns, and scrubbers or fan- demister combinations on smelt tanks; and the requirement for thermal oxidation of noncondensibles from digesters and evaporators will be met by burning in lime kilns or gas-fired furnaces. As a result of these standards, particulate emissions from kraft pulp mills will be reduced by 60% for the period 1970-1975, while malodorous emissions will be reduced by 90% for the same period. The cost of control is being reduced through the tax incentive law, passed by Washington Legislature in 1967. (Author summary modified)

43414

Weeks, Larry

CONTROL OF EMISSIONS FROM AN EXISTING KRAFT RECOVERY BOILER. Preprint, American Chemical Society, Washington, D. C., 7p., 1971. (Presented at the American Chemical Society, Northwest Regional Meeting, 26th, Bozeman, Mont., June 16-18, 1971.)

The conversion of a conventional, direct-contact evaporator, Babcock and Wilcox recovery boiler to a new low emission concept recovery boiler design is described. The latest recovery technology is based upon the elimination of the direct contact of flue gas and black liquor, and the use of high efficiency dry-bottom electrostatic precipitators for particulate collection. The unit is a two-pass, forced circulation unit, rated for 49,000 lb/hr of evaporation. The liquor solids are raised from a feed of 39-43% to a product of 60-63%. These product solids are monitored continuously with a refractometer. From a storage tank, the liquor is pumped to a sluice tank under the precipitator, where the recovered salt cake is mixed with liquor then to the mix tank where the dry makeup salt cake is added and then fired in the furnace. Steam is used for evaporation, and the vapor is used to heat the weak liquor feed to the multiple effect evaporators and the hot water in two separate condensers. A large vertical steel-tube Economizer is used to recover the heat in the flue gas previously used for direct contact evaporation, and to lower the flue gas temperature entering the precipitator. The electrostatic precipitator employed is designed for an efficiency of 99%. The results after 6 weeks of operation showed good operation of the concentrator in maintaining satisfactory firing solids, excellent steam production, and a reduction in TRS emissions from more than 400 ppm to less than 17.5 ppm. There were also no significant amounts of sulfur dioxide emitted from the stack. Initial conveying problems in the bottom of the precipitator were solved with bigger screw conveyors. Work is in progress to improve the operation of the electrostatic precipitator and to bring the particulate emission within the standards of the State of Montana.

43480

Hough, G. W. and R. L. Stewart

EMISSION CONTROL OF EXISTING KRAFT RECOVERY SYSTEMS. Technical Assoc. of the Pulp and Paper Industry, New York, Tappi Eng. Conf., 26th, Proc. 1971, p. 83-95.

Air emission control from the evaporators and recovery furnace in existing mills is discussed. Complete black liquor oxidation is required to control odor emissions from the miltiple effect evaporators and the direct contact evaporator. Without it, elimination of the direct contact evaporator is required. Control of emissions from the recovery furnace is dependent upon type of equipment and operating conditions. A venturi scrubber will not meet the most stringent particle emission regulations, and an electrostatic precipitator must have a 99% collection efficiency to meet present day standards. The efficient removal of particulates from the recovery stack will reduce the visibility of the plume. Installation of most emission control equipment in an existing mill cannot be economically justified.0

43482

Gommi, J. V.

REDUCED ODOR EXPERIENCE WITH CE ACE UNITS. Preprint, American Chemical Society, Washington, D. C., 16p., 1971. 6 refs. (Presented at the American Chemical Society, Northwest Regional Meeting, 26th, Bozeman, Mont., June 16-18, 1971.)

The kraft mill has been the source of many sulfur-bearing odorous gases such as hydrogen sulfide, alkyl mercaptans, alkyl sulfides, alkyl disulfides, sulfur dioxide, and sulfur trioxide. The recovery unit has made a contribution to this odor level. Recovery unit emission of total reduced sulfur compounds is predominantly H2S and the remaining alkyl groups are mostly methyl. This emission is primarily from two areas: the concentration of unoxidized strong liquor by direct contact with hot flue gas in a cascade evaporator or venturi scrubber; and the furnace area, particularly where furnaces are run at overload. Odors from these two sources can be minimized by elimination of direct fuel gas contact evaporation of unoxidized black liquor and proper furnace operation. Commercially available schemes for the former are gas contact evaporation, the air contact evaporator (ACE), the laminaire air heater (LAH), the large economizer, and the combined LAH-ACE. Important furnace operating parameters are black liquor oxidation, black liquor gun spray size, percent zone liquor solids fired, furnace operating load vs. design rating, furnace zone air ratios, excess air, oxidation zone turbulence, mill sulfidity, soot blowing, air temperature, furnace and bed temperature, and bed height. The experience of Chemical Engineering with the ACE unit is discussed.

43544

Backstrom, Bjorn Olav

AIR CONSERVATION PROBLEMS IN THE FINNISH FORESTRY INDUSTRY. Int. Air Pollut. Control Noise Abatement Exhib. Conf. (Proc.), Jonkoping, Sweden, 1971, p. 2:53-2:64. (Sept. 1-6.)

Air conservation problems in the Finnish forestry industry are reviewed. Laws regulating the emission of sulfur dioxide, hydrogen sulfide, and particulates are discussed. The forest industry s localization and production is described. Control methods considered by the sulfite and sulfate pulp industry include the use of boilers with flue gas purification, electrostatic precipitators, scrubbers, cyclones, and evaporators.

43611

Segerfelt, Bror Natanael

PROCESS FOR THE REMOVAL OF MALODOROUS GASES PRODUCED IN SULFATE AND SODA PULP MANUFACTURING PROCESSES. (Procede pour l eliminati des gaz malodorants produits dans la fabrication de la cellulose au sulfate et de la cellulose a la soude). Text in French. (Assignee not given.) French Pat. 687,335. 7p., April 28, 1930. (Appl. Dec. 27, 1929, 2 claims).

A process for the removal of malodorous gases formed during the sulfate or soda pulp processes is described. The gases are cooled to dew point or saturated with water and treated with agents capable of oxidizing, absorbing, or combining with the malodorous constituents. The treatment is made at a maximum gas flow rate of 0.5 m/sec and under a pressure nearly equal to the atmospheric pressure in a temperature range of 20-120 C. The absorption is made in a series of absorbers containing water and alkaline solutions, preferably of fresh liquor to which hydrocarbons of the terpene or camphor groups are added. Combustible gases are burned and then mixed to the rest prior to the above treatment. Gases produced during cooking and extraction and released from digesters are purified by absorption in high-viscosity alkaline liquor solutions prior to combustion.

43635

Kringstad, Knut P., William T. McKean, Jan Libert, Peder J. Kleppe, and Cheu Laishong

ODOR REDUCTION BY IN-DIGESTER OXIDATION OF KRAFT BLACK LIQUOR WITH OXYGEN. Technical Assoc. of the Pulp and Paper Industry, New Yor Tappi Eng. Conf., 26th, Proc. 1971, p. 29-54. 34 refs.

Laboratory studies showed that sodium sulfide was rapidly oxidized to thiosulfate by the injection of oxygen into the digester at the end of a kraft cook. Two moles of oxygen/mole of sodium sulfide were required to reduce the sodium sulfide content in the black liquor by 90% under the conditions used. The injection of this amount of oxygen also reduced the content of methyl mercaptan in the liquor by more than 99% without increasing the content of dimethyl disulfide. The content of dimethyl sulfide was not influenced to any noticicable degree. The oxygen injection was found not to influence the pulp yield or the strength properties of the pulp. However, the pulp was somewhat easier to beat and had a slightly lower brightness. (Author abstract)

43774

Andreasson, Stig and Carl-Elis Bostrom

DEALING WITH AIR POLLUTION. Tek. Tidskr., 102(11):22-28, June 1972.

The total emission of sulfur dioxide in Sweden was about 870,000 metric tons during 1970, of which 715,000 tons emanated from the burning of fuel oil and 155,000 tons from industrial processes. The SO2 concentration in a built up area can be reduced locally by centralizing the heating or by electric heating. By an Act of July 1969, fuel oil must not contain more sulfur than 2.5% by weight unless satisfactory flue gas control equipment is installed, and fuel oil burned within the greater Stockholm area and Goteborg must not contain more sulfur than 1% by weight. The Swedish company Bahco has developed a scrubbing process where the flue gases are treated with lime in two stages. The lime consumption is 0.43 tons/hr and the SO2 separation is about 97%. Dust particles are produced in the matallurgical process in the cupola furnace, sintering, and the Kaldo process. The dust separators used with cupola furnaces are single cyclone separators, multiple cyclone separators, bag house filters, electrical precipitators, or scrubbers. The most common type of scrubber used earlier was the spray chamber with an efficiency of 30 to 60%. For smaller furnaces mechanical separators and simple scrubbers are usually sufficient, whereas larger furnaces demand more effective separation equipment. The Kaldo process is an oxygen-blown method for steel manufacture employing a rotary furnace and delivering a 100 ton smelt after approximately 2 hours. All Kaldo furnaces in Sweden are equipped with electrical precipitators in order to reduce the emitted particulate matter. Control of odorous emissions from the pulp industry and of hydrogen sulfide, mercaptans, and hydrocarbons from the oil refinery industry are discussed. Regulations concerning motor vehicle exhausts are outlined. Investment costs are cited.

43796

Ikari, Yoshikatsu

POLLUTION CONTROL PROBLEM IN PULP AND PAPER INDUSTRY - ITS POLICY AND TECHNOLOGY. (Kami parupu kogyo to kogai mondai - Seisaku kara gijutsu e -). Text in Japanese. Seni to Kogyo (Textile and Industry), 5(3):140-152, March 1972. 9 refs.

A review of the pulp and paper industry and its problems is presented. Pulp and paper industry of Japan has recorded an unusually high growth rate in the 1956-1970 period. Japan now ranks the world s third in pulp production, only next to the U. S. and Canada, and second in the paper board production only next to the U. S. Taking 1960 as 100, the production indexes for 1970 are 249.1 and 287.5, respectively. This rapid growth has resulted in two major problems, import of the raw material and rapidly aggravated pollutions, especially water pollution. Wheter the industry decides to continue the thorough production policy, under which the manufacturing of all the pulp and paper products begin with the processing of raw materials, or change this policy to captive import, in which the industry will depend on the import of pulp and paper products manufactured by the overseas plants operating on Japanese capital, the pollution problem remains yet to be solved. According to a MITI survey, the industry s capital investment for the installation of pollution control plants and equipment in 1970-1973 is estimated at $195,751,300, of which 79.86% is for the control of water pollution. 12.09% for flue gas purification, 4.38% for disposal of wastes, 1.85% for noise control, and 1.12% for the control of offensive odors. Of the total investment in 1970-1972, that for pollution control is estimated to account for 33.3% in pulp manufacturing, 9.7% in paper manufacturing, and 11.3% in paper board manufacturing. Air pollution sources in the industry include ordinary boilers, KP boilers, and lime kilns.

43851

Dyck, A. W. J.

FOCUS ON PULPING--A NEW-PROGRESS REPORT. Am. Paper Ind., 53(3): 40-42, March 1971.

Recent developments in pulping technology in the following areas are discussed: sulfate pulping problems and process modification to meet pollution regulations; operating problems encountered with continuous digesters and attributed to poor chip quality; a two- stage soda-oxygen pulping process; trends in sulfite pulping; the high-pH sulfite process developed at CIP Research Ltd., which has the potential of competing with the kraft process in using a wide range of wood species and producing sulfite pulps with strength properties equal to those of kraft pulps; and the growing importance of some fiber producing annuals. A recent study showed that nothing less than an electrostatic precipitator with a collection efficiency of 99% will meet the most stringent regulations. Complete black liquor oxidation is required to control odor emission from multiple-effect and direct contact evaporators. Much of the emission from pulp processing is caused by overloaded recovery boilers in the older mills.

43879

KAMLOOPS POLLUTION CURBS ARE B.C. S MOST EXTENSIVE. Can. Pulp Paper Ind. (Vancouver), 25(7):21-25, July 1972.

Weyerhaeuser Canada Ltd. s new 1250 tons/day bleached kraft pulp mill at Kamloops, British Columbia, brings into effect close use of the forest resource, as well as an extensive pollution abatement program. Beehive burners have in the past burned constantly, but now sawdust and shavings will be used for the production of sawdust market pulp, while hog fuel will also be shipped to the Weyerhaeuser pulp mill for use in hog fuel burning boilers where the mill will generate most of its own power. The mill was designed to burn off a high percentage of odorous gases and waste products, so that as little odor and effluent as possible are returned to the environment. Depending on the nature of the waste, it is burned in the lime kiln or power boilers. A gas containment system will collect blow gases from the digester so that noncondensable organic sulfur compounds can be separated out and then delivered to the lime kiln where they are burned. Burning of the sulfur compounds produces heat and reduces the amount of fuel required for the kiln. Sulfur dioxide is removed from the kiln flue gas by two wet scrubbers in series. Fly ash removal systems, water effluent treatment, a high level stack, and other pollution abatement techniques are indicated.

44198

Pincovschi, E. and I. Constantinescu

SIMULTANEOUS CLEANING OF AIR AND WATER BY COMBINED METHODS. PROTECTION OF THE BIOSPHERE. (Depoluarea simultana a apei si atmosferei prin metode combinate - mijloc de a proteja biosfera). Text in Rumanian. Rev. Fiz. Chim., Ser. A, 8(11):401-405, Nov. 1971. 23 refs.

Environmental control methods to provide combined water and air protection under conditions determined by modern technology are reviewed. Hydrochloric emission control can be achieved by means of a water-sprayed scrubber. To avoid pipe damage from the acid- containing water, the scrubber is filled with limestone and the effluent water is pH-controlled. Foam formation is prevented by means of a water spraying system. Sulfur dioxide emission control in pulp producing plants can be achieved by adsorption by molecular sieves or other solid adsorbents. Dust emission control from cement producing plants can be achieved by dust collectors applied to the dust carrying gaseous phase and then by utilizing washing scrubbers and centrifugal separators. Included are sketches describing the above procedures. At the present stage of technology the combined approach focusing on both water and air pollution control would be the only way to maintain the environment.

44394

Heaney, J. P. and L. Doughty

OPTIMAL ATMOSPHERIC EMISSION CONTROL IN THE WOOD PULP INDUSTRY. Atmos. Environ., 6(2):93-102, Feb. 1972. 10 refs.

A mathematical programming model was formulated to determine the optimal atmospheric emission control alternatives for the pulp industry. Generalized multi-path diagrams were developed showing the emission sources, the unit emissions from these sources, and the available control alternatives. Using these diagrams it is possible to depict a given mill by selecting the appropriate flow paths. The formulation of the optimization model as a mixed integer-linear programming problem is presented. Then the results of a sample analysis using the model are described. A procedure is presented for determining the net cost of particulate emission standards as well as a sensitivity analysis of the impact on the optimal solution of varying the value of recovered chemicals. (Author abstract)

44818

Sultzer, N. W. and C. E. Beaver

ALKALI RECOVERY BY ELECTRICAL PRECIPITATION. Paper Trade J., 1936:33-35, Jan. 23. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, New York, N. Y., Feb. 17-20, 1936.)

Black liquor contains two items of value to the pulp manufacturer: first, the sodium compounds which may be recovered and used again, thus reducing the amount of fresh chemicals required, and, second, the heat value of the organic compounds which may be used for steam generation. The black liquor is therefore partially concentrated in evaporators and fed to recovery furnaces in which the carbonaceous and combustible materials are burned, releasing heat. The heat is used for evaporating the black liquor for generating steam and reducing the sodium compounds to black ash. A considerable amount of sodium salts are evolved as dust and fume in this burning operation, and the amount of such sodium salts evolved usually represents a major loss in the recovery operation. The recovery of these sodium salts by Cottrell electrical precipitation equipment is discussed, including the composition of recoverable sodium salts, the magnitude of alkali stack losses, equipment for removing suspended matter from gases, the composition and disposal of material collected in precipitators, and operating characteristics of precipitators. Power consumption, pressure drop, labor, and maintenance are mentioned.

44890

Coe, E. L., Jr. and J. L. Ma

ELECTROSTATIC PRECIPITATION AND NITROGEN OXIDES IN FLUE GASES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 28p., 1972. 3 refs. (Presented at the Air Pollution Control Association Annual Meeting, 65th, Miami, Fla., June 18-22, 1972, Paper 72-106.

The effect of electrostatic precipitation on nitrogen oxides by simultaneous and continuous monitoring of the nitrogen oxides content in the flue gases at the inlet and outlet of a precipitator are presented. Measurements were made with two Dynasciences nitrogen oxide monitors on four precipitators in power, steel, cement, and pulp industries. They include two types of coal, two load levels, a range of excess oxygen content in the flue gases (3.5 to 77.2%), two outlet distances from the precipitator (5 and 50 ft), and power input to the precipitator at 0, 25, 50, 75, and 100%. The precipitators had practically no immediate or delayed effect on the nitrogen oxide content in the flue gases, but it increased with increase in boiler load and increase in excess oxygen above 5.5%. The precipitators had practically no effect on the nitrogen oxide content in the flue gases. The cement kiln precipitator reduced nitrogen oxide in the precipitator by 11.2%, and the pulp mill recovery boiler precipitator reduced it even more. These reductions are not related to air dilution. In the pulp mill precipitator, the nitrogen readings at the outlet of the precipitator might have been biased by caustic sprays immediately following the sampling point, or by nitrogen oxide decomposition in the precipitator catalyzed by the organic fly ash and salt cake in the gas stream. Electrostatic precipitation does not increase the nitrogen content in the flue gases. Under some conditions, there is actually a reduction of nitrogen oxides in the precipitator. (Author abstract modified)

45019

Veeramani, Hariharan

DESIGN AND MASS TRANSFER ASPECTS OF A VOLATILE SULFUR RECOVERY PROCESS FOR KRAFT PULPING. Washington Univ., Seattle, Dept. of Chemical Engineering, Thesis (Ph.D.), Ann Arbor, Mich., Univ. Microfilms, Inc., 1970, 299p. 158 refs.

Possibilities of a new approach to sulfur recovery in the kraft wood-pulping process are considered. Current practice involves minimizing the release of gaseous sulfur compounds from liquid black liquor until the latter is burned in a recovery furnace to recover chemicals and thermal energy. Problems in odor control arise in carrying out this process in practice. The proposed process involves intentionally volatilizing sulfur compounds and absorbing them separately, allowing the combustion of a black liquor substantially free of sulfur compounds. The overall design aspects and material and energy balances are described which would result if such a process is utilized. The addition of four new operating units to traditional continuous recovery systems is proposed. Each of these is a counter current vapor-liquid mass transfer column and designated precarbonator, hydrogen sulfide generator, carbon dioxide generator, and hydrogen sulfide absorber.

C. MEASUREMENT METHODS

00383

M. D. High and S. W. Horstman

FIELD EXPERIENCE IN MEASURING HYDROGEN SULFIDE. Am. Ind. Hyg. Assoc. J. 26, 366-73, Aug. 1965. (Presented at the American Industrial Hygiene Conference, Cincinnati, Ohio, May 6-10, 1963.)

Hydrogen sulfide is one of the air pollutants associated with the operation of kraft pulp mills. Two methods for measuring hydrogen sulfide are described; the methylene blue method described by Jacobs and the lead-acetate impregnated bitter paper. It is pointed out that the methylene blue procedure gave results an average of 20 parts per billion lower than the strip filter paper sampler. The study was conducted in the areas of Lewiston, Idaho and Clarkston, Washington.

00551

D. H. Longwell

THE NATIONAL COUNCIL FOR STREAM IMPROVEMENT AIR POLLUTION STUDIES. Preprint. (Presented at the Second Annual Conference, Pacific Northwest International Section, Air Pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

The research program of the National Council for Stream Improvement in air pollution, which is supported entirely by the pulp and paper industry, has been reviewed. The program encompasses definition of the problems, development of sampling and analytical techniques, dissemination of findings through technical publications, participation in technical meetings by both the Council staff and mill personnel, and technical assistance from the Council staff upon request. (Author's summary)

00947

D. F. Adams and R. K. Koppe

DIRECT GLC COULOMETRIC ANALYSIS OF KRAFT MILL GASES. J. Air Pollution Control Assoc. 17, (3) 161-5, March 1967. (Presented at the 59th Annual Meeting, Air Pollution Control Association, San Francisco, Calif., June 20-25, 1966, Paper No. 66-89.)

A new bromine, microcoulometric titration cell has been used with a commercially-available microcoulometer for the detection and analysis of sulfur-containing gases in various kraft mill emissions. Separation of the constituents of the gaseous mixtures emitted from mill sources including the recovery furnace, digestors, evaporators, lime kiln and dissolvers was accomplished on an eight-foot, 3/16' stainless steel column packed with 10% Triton X-305 on 60-80 mesh Chromosorb G, DMCS-treated. The column was isothermally operated at 30 C for 4-6 min and then rapidly raised to 70 C. The exact program was varied with the type of sample analyzed. Each source gas was initially screened by direct injection of 0.01 to 0.1 ml. of gas to determine whether or not disproportionately large concentrations of one or more components were present. Appropriate sample volumes were then selected to provide 'on-scale' recorder peaks for the major constituents. Elution times for the major constituents were observed so that these compounds could be vented at the proper time following injection of large sample volumes (up to 10 ml.) for detection and analysis of minor constituents. Venting of the high concentration compounds was necessary when analyzing large volume samples to maintain near equilibrium titration conditions in the microtitration cell. (Author abstract)

00965

R. Cederlof, M. L. Edfors, L. Friberg, and T. Lindvall

ON THE DETERMINATION OF ODOR THRESHOLDS IN AIR POLLUTION CONTROL - AN EXPERIMENTAL FIELD STUDY ON FLUE GASES FROM SULFATE CELLULOSE PLANTS. J. Air Pollution Control Assoc., 16(2):92-94, Feb. 1966.

From the hygienic point of view, not only the health hazards caused by air pollutants but also the odor from emitted flue gases should be reduced to a minimum. An effective control of the risk of odor at ground level presupposes knowledge of the source concentration of the odoriferous gas as well as its odor threshold has to be estimated empirically, as the flue gases often contain a complex mixture of different odoriferous substances, the odor thresholds of which are in most cases unknown. For this purpose a method has been developed for estimating the odor thresholds of flue gases emitted from different industrial processes. The method, a field method, is based on an exposure procedure, a number of subjects compare different concentrations of the flue gas with samples of fresh air and decide at what concentration the flue gas is no longer noticeable. The gas samples used are neither compressed, nor absorbed or heated before the exposure test. The method has been used in two studies on gases from Swedish sulfate cellulose plants. In order to estimate the effect on the odor threshold of different deodorizing measures, gas samples were taken not only from the stack but also from different phases in the production process. The results and a brief discussion on the practical applications of the method are given. (Author abstract)

01071

J.B. Risk F.E. Murray

CONTINUOUS RECORDING OF SULFUROUS GASES CONCENTRATIONS IN FLUE GASES. Can. Pulp Paper Ind.(Vancouver) 4 pp. Oct. 1964. (Presented at the Fifth International ISA Pulp and Paper Instrumentation Symposium, Vancouver, British Columbia, May 18-23, 1964.)

The methods of analysis used in currently available instruments for the continuous measurement of hydrogen sulfide and sulfur dioxide are critically reviewed. An instrument for continuously measuring the concentrations of these gases in a process stream in the concentration range of 25 to 2500 ppm is described and its advantages over existing instruments illustrated. Some plant results obtained with the instrument are presented. The instrument, which utilizes the analytical system of a commercial ultraviolet analyzer, had been in plant operation for over two months. (Author abstract modified)

01542

I.H. Williams F.E. Murray

STUDIES ON THE GAS CHROMATOGRAPHIC ANALYSIS OF KRAFT MILL SULPHIDES. PART 1 - COLLECTION AND ANALYSIS OF GASEOUS SAMPLES. Pulp Paper Mag. Can. (Quebec), 67(8):347-352, Aug. 1966. (Presented at the Annual Meeting, Technical Section, Canadian Pulp and Paper Association, Montreal, Jan. 25-28, 1966.)

The direct gas chromatographic analysis of kraft mill effluents for methyl sulfide, methyl disulfide and methyl mercaptan has been studied and sources of error associated with the method have been evaluated. Reliable results are obtainable if glass sample containers free of stopcock grease are used and suitable corrections are made for the presence of water. To avoid possible loss, samples should not be stored for periods longer than forty- eight hours. A suitable analytical procedure is described. (Author summary)

03789

J. S. Leonard

STACK EMISSION SAMPLING. TAPPI 49, (10) 84A-85A, Oct. 1966. (Presented at the Shipley Award Program, Pacific Section, Technical Association of the Pulp and Paper Industry, West Linn, Oreg., Mar. 15, 1966.)

Potential air pollutants in kraft pulping emissions consist essentially of solid particulate and sulfur containing malodorous gases. The solid particulate is generally of a caustic nature, whereas the malodorous gases are of an acidic nature. In an effort to monitor these emissions effectively, a series of emission sampling stations and specialized sampling devices have been constructed. The particulate sampling device operates on an electrostatic precipitation principle and allows for the simultaneous sampling of solid particulate and malodorous gases. Four sampling stations are located on vertical stacks, at least five diameters downstream from obstructions. Sheltered work areas are provided with electricity and compressed air. (Author abstract)

04883L

National Council for Stream Improvement, New York City.

A MANUAL FOR DIRECT GAS CHROMATOGRAPHIC ANALYSIS OF SULFUR GASES IN PROCESS STREAMS. (Atmospheric Pollution Technical Bulletin No. 30.) June 1966. 27 pp.

The attached bulletin presents a detailed method for sampling and gas chromatographic analysis of kraft mill gases at their sources. This bulletin supersedes Bulletin 13, September 26, 1960, which is obsolete and is no longer recommended. In this new, simplified method, source samples may be taken either in evacuated pressure bottles, plastic bags, modified McLean tubes, or directly in gas-tight syringes. A small volume of the source gas (0.02 - 2.0 ml.) is injected directly onto the chromatographic column in a temperature-programmed oven. The eluted sulfur compounds are detected with a bromine, microcoulometric titration cell. The instrumentation and methodology were field tested at a West Coast kraft mill. Approximately 20 minutes is required to complete a single analysis for sulfur compounds ranging in molecular weight from hydrogen sulfide through dimethyl disulfide or higher. The rapidity of the analytical technique permits rapid qualitative and quantitative determination of the components of gaseous sulfur emissions from all sources, determination of the effectiveness of various odor control processes, and evaluation of the effect of changes in mill operating conditions upon quantity and type of emissions. (Author abstract modified)

04885L

National Council for Stream Improvement, New York City.

MEASURING NON-STEADY FLOW IN INDUSTRIAL STACKS. (Atmospheric Pollution Technical Bulletin No. 27.) Oct. 1965. 12 pp.

In attempting to develop methods of measuring mass emission rates from kraft pulp mills, it became necessary to devise some satisfactory technique for measuring the intermittent non-steady flow found in several vents. Actually two dissimilar problems existed; each requiring a different approach. The first was with large vents (12' diameter or larger) where little or no back pressure could be tolerated. The flow through these vents can vary from 0 to over 70,000 cubic feet per minute during a one minute period. The second was with small diameter vents (4' to 8' diameter) through which non-condensable gases and steam were vented from high pressure process units. Back pressure could be tolerated in these smaller vents. Satisfactory methods of measuring non-steady flow in two types of industrial vents have been presented. These have been field tested and found to be workable. The photo-pitot traverse technique should be used primarily for calibration purposes with a single impact tube used for actual sampling work. The nozzle section is light enough that it can be handled whenever sampling is actually done at various ports in a plant. The nozzle can be used for discharge points while the venturi section can be used at intermittent points in a pipe network. No claim is made that these are highly sophisticated techniques, rather that they are simple and useful in obtaining a solution to a rather thorny problem.

04886L

National Council for Stream Improvement, New York City.

A METHOD OF MEASRUING THE CONCENTRATION OF SULFUR COMPOUNDS IN PROCESS GAS STREAMS. (Atmospheric Pollution Technical Bulletin No. 28.) Dec. 1965. 12 pp.

The method described in this paper has been shown to give satisfactory accuracy and precision to answer general requirements for determinating all 5 of the compounds mentioned. Sampling is relatively simple and analysis requires only a pH meter and a Beckman Model B Spectrophotometer or a similar instrument. SO2 is determined by a modification of the West and Gaeke method using a single train of 3 bubblers. A 4-bubbler train operated in parallel to the SO2 train is used for determining the reduced sulfur compounds. CdCl2 can be used as an absorbing reagent for H2S and mercaptans. Both gases form precipitates when they react with the CdCl2 contained in the first 2 bubblers of the train. The precipitates are dissolved in HC1 and are titrated iodometrically. Alkyl sulfides and disulfides are absorbed in benzene contained in the final 2 bubblers. Iodine forms a color complex with alkyl sulfide compounds. The concentration of the complex can be determined spectrophotometrically. The formation of this complex in benzene permits direct analysis for methyl sulfides using a very small aliquot of the absorber volume. A bromide-bromate solution is used to titrate the remainder of the benzene to determine total alkyl sulfides and disulfides. Disulfides are then computed by difference. The benzene is acidified prior to titration so that bromine will be formed. The method described has been field tested successfully at several kraft pulp mills. The method has the advantages of simplicity, inexpensive instrumentation requirements, and of being directly applicable to all gas streams in a mill regardless of constituents or concentrations encountered.

04945

Harding, C. I., E. R. Hendrickson, and R. S. Sholtes

MEASURING NON-STEADY FLOW IN INDUSTRIAL VENTS. J. Air Pollution Control Assoc., 16(1):12-14, Jan. 1966.

Pitot measurements have long proved satisfactory for measuring flows from most sources encountered in the air pollution work. Occasionally an operation is encountered which exhibits such wide flow variation with time that pitot measurements are meaningless. Two methods have been developed which measure the volume rate of discharge from such sources. A detailed description of the method (Large Duct and Small Vent Techniques) and the results of the field testing of both are given. For large ducts where very little back pressure could be tolerated, it was thought to be undesirable to utilize a head meter. Therefore, consideration was given to the use of a pitot tube or some modification such as an impact tube device. The final configuration consisted of a rack holding six pitot tubes which were inserted at the appropriate positions within the stack in order to determine an instantaneous one directional traverse across the stack. These tubes were connected to dial-type differential head gages (Magnahelic gages). A single frame movie camera was installed in the same enclosure as the gage panel to take a photograph of the entire dial array once every 20 seconds. The measurement procedure consisted of assembling the equipment on location, checking all the gages for proper operation, setting the clock, and starting the equipment. Although the equipment used in this technique was somewhat cumbersome, it did prove to be an effective way of measuring non-steady flow in large industrial vents. It is not the type of equipment which would be used routinely in conjunction with sampling, but would be used primarily for calibration purposes. Once a duct is calibrated, it then should be possible to use a single point reference for future sampling activities. For small high pressure vents where a certain amount of back pressure can be tolerated, the problems of flow measurement are greatly simplified. The hardware finally selected consisted of a nozzle section. The high pressure tap was located one pipe diameter upstream from the entrance of the convergent section. The low pressure tap was installed in the center of the throat section. A six-inch diameter approach section was selected as satisfactory to measure flows from the majority of small vents encountered in a kraft mill. A sampling port was included upstream from the convergent section. This permitted simultaneous gas sampling and flow measurement. A water manometer was used to measure the differential head. An equation used to reduce data was developed. An estimate of mass emission rates can be made based on the discharge characteristics and concentration samples.

06385

Falgout, D. A. and C. I. Harding

DETERMINATION OF H2S EXPOSURE BY DYNAMIC SAMPLING WITH METALLIC SILVER FILTERS. J. Air Pollution Control Assoc., 18(1):15-20, Jan. 1968. 24 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967.

This paper describes a method of determining exposure to H2S and mercaptans by measuring the decrease in reflectance of Ag membrane filters resulting from the formation of Ag2S on the filter surface. SO2, (CH3)2S and (CH3)2S2 do not react with the silver membrane. The method depends on the reaction between metallic Ag and H2S: H2S + 2Ag + 1/2 O2 yields Ag2S + H2O. Mercaptans also react with Ag in a similar manner. An appropriate surface, an excess of O2 and a condensed water film are necessary for these reactions to proceed rapidly and quantitatively. The NO2 concentration is significantly reduced by Ag membrane filters. Results indicate the oxidation of Ag2S to Ag2SO4 by O3 is slow and that the reflectance loss of clean Ag filters caused by O3 is small. There is little opportunity for UV light to affect the Ag membrane if the filter holders are taped. Three 23 hr. samples/wk were taken at a flow rate of 0.9 lpm. Under these conditions the reflectance losses ranged from 0-37 reflectance units/cu m of sampled air. The Ag filters appear to be more sensitive to sulfide gases at high humidities. This tends to enhance the value of the method as a measure of non-health effects, such as paint sensitivity.

06526

D. F. Adams

GAS CHROMATOGRAPHY APPLIED TO ATMOSPHERIC KRAFT ODORS (FINAL REPT. MAY 1, 1963 - APR. 30, 1966). Preprint. 1966.

The objective was to analyze qualitatively the malodorous, kraft pulp mill air pollutants in the ambient air by the gas-liquid chromatographic technique, including the use of ionization detection and Golay columns. Gas chromatographic detectors, available in 1963, were evaluated for sulfur-gas sensitivity and specificity. Coulometric detectors gave the best overall sensitivity and specificity. Therefore, the research was continued, using the coulometric detection principle. A sulfur-specific, bromine coulometric detector, having a sensitivity approaching the human sensory threshold, has been developed as a result of this research. This cell is a significant improvement over the previously available iodine coulometric detector. Two circuit improvements were made in the coulometer which permitted greater reproducibility and control of the critical detector bias voltage. Losses of sulfur-containing compounds on the gas chromatographic columns studies were found to be so large that direct GLC analysis of ambient air was impossible. The magnitude of these losses have been established. Using currently available GLC columns and detectors, a successful technique for analysis of sulfur compounds in the ambient air will have to rely upon pre-concentration of these compounds by either adsorption or freeze out.

07214

Bethge, Per Olof and Lalla Ehrenborg

IDENTIFICATION OF VOLATILE COMPOUNDS IN KRAFT MILL EMISSIONS. Svensk Papperstid. (Stockholm), 70(10):347-350, May 31, 1967. 3 refs.

Identification of compounds contributing to the odour from kraft mills was accomplished by gas chromatography, and in some cases in combination with mass spectrometry. Attention was centered on the most volatile compounds. Besides seven terpenes, 25 compounds were identified.

08312

Okita, Toshiichi Yamashita, Shushi Nishino, Eisaku and Kaneda, Kazuko

MEASUREMENT OF SIZE DISTRIBUTION OF SODIUM SULFATE PARTICLES IN THE FLUE GAS OF A KRAFT PULP MILL. Text in Japanese. Bull. Inst. Public Health (Tokyo), 16(1):41-44, March 1967. 3 refs.

Size distribution of sodium sulfate particles was measured using a cascade impactor and the inertial impaction method. Particles were found to be formed by the coagulation of finer particles. Their maximum size was 2 mm. An equation is given which roughly expresses the size distribution. Usually the concentration of the particles was too high to be measured by the cascade impactor, so that a centrifugal particle size separator fitted with a suction pump was used. This combination was found to be a useful tool for size distribution measurements.

08354

Brink, D. L., and J. F. Thomas, and D. L. Feuerstein

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. II. ANALYTICAL ASPECTS. TAPPI, 50(6):276-285, June 1967. 25 refs. (Presented at the 51st Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21-24, 1966.)

Gaseous and liquid products isolated by pyrolysis of kraft black liquor, were analyzed qualitatively and quantitatively using gas-liquid chromatography with detection by flame ionization. More than 60 compounds were detected in the pyrolysis liquid and at least 32 of these were present in the pyrolysis gas. Using the microcoulometric titration system, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and at least 19 unidentified sulfur-containing components were detected in the pyrolysis products; 7 of the major components were determined quantitatively. Using cochromatography and the methods of detection noted, the identities of methyl mercaptan, dimethyl sulfide, and dimethyl disulfide were verified and tentative identifications of several other sulfur-containing products were also made. Hydrogen, oxygen, nitrogen, methane, carbon monoxide, ethane, carbon dioxide, and acetylene were resolved and determined quantitatively. Hydrogen sulfide, methyl mercaptan, and five unidentified components were also qualitatively detected. Sulfur present in pyrolysis residues was determined using a wet oxidation procedure. A powerful analytical method has been developed for detailed study of the effects of recovery furnace operation on such emissions and it should prove to be a valuable aid to industry. With adequate development, pyrolysis carried out independently of gaseous, liquid, and solid products could provide an answer to complete odor control; in addition, isolation of organic by-products may be feasible. AAM

08355

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART I: THEORETICAL CONSIDERATIONS. TAPPI, 46(1):1-5, Jan. 1963. 4 refs.

A new method is proposed for the simultaneous collection of all pollutants from gaseous kraft-mill effluents and process streams. The pollutants are in part frozen out in an empty cold trap, and in part dissolved in traps containing ethylbenzene as a solvent at about minus 78 C. Formulas are derived that provide quantitative information on the performance of these traps toward pollutants having a wide range of boiling points. These formulas give the concentration of a pollutant in the solvent, as a function of the sample volume; the sampling time; the percentage of a pollutant retained by a trap from a polluted airstream; and the instantaneous concentration of a pollutant in the exhaust air from a trap. The formulas are not limited to kraft-mill pollutants. The special case of a poorly absorbed pollutant is treated, and a sampling program for this case is prescribed. The distribution ratios of methyl mercaptan, hydrogen sulfide, and sulfur dioxide between an airstream and a solvent are calculated, and for the first two, values are also found by experiment. (Author's abstract)

08356

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART II: A LABORATORY STUDY OF THE COLLECTION OF POLLUTANTS FOR ANALYSIS. TAPPI, 46(1):5-11, Jan. 1963. 5 refs.

An experimental study was made of the performance of traps, in collecting kraft-mill pollutants from an air stream. The traps were in a mixture of dry-ice and acetone. Some traps in the train were empty; others contained ethylbenzene as a solvent. A convenient experimental method is described for artificially producing a polluted air stream, and for evaluating the performances of traps. The distribution was found of hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide among the traps of the train. The effect of flow-rate, volume of solvent, and trap design on trap performance was measured. The effect of varying the degree of air turbulence in an empty cold trap was studied. It was confirmed that cold ethylbenzene is a satisfactory solvent for all the pollutants except hydrogen sulfide. For this latter pollutant, an aqueous solution of cadmium was used to trap it. A study was included on the losses of the pollutants that might occur on extended storage of their ethylbenzene solutions. Apparatus and a procedure are described for the concentration of the original ethylbenzene solution of pollutants, to improve the sensitivity of the method. (Author's abstract)

08357

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART III: THE ANALYSIS OF COLLECTED POLLUTANTS BY GAS CHROMATOGRAPHY. TAPPI, 46(1):11-14, Jan. 1963. 4 refs.

The qualitative and quantitative analysis of kraft-mill pollutants in ethylbenzene by using gas chromatography is discussed. Columns of tri-m-cresyl phosphate and of Carbowax 1540 are proposed for use at 35 and 85 C. These columns permit the resolution of all known kraft-mill pollutants. Techniques are described for qualitative analysis. They include the two-column method, and graphs prepared by this method are presented for homologous series of mercaptans, ketones, esters, and normal alcohols. It is emphasized that the unequivocal identification of an unknown pollutant is rarely possible by gas chromatography alone. Quantitative analysis is also described, including the preparation of standard solutions and the presentation of prepared calibration curves. These curves were straight lines. The use of an ultrasensitive detector, the ionization chamber, is briefly discussed. (Author's abstract)

08358

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART IV: A FIELD KIT FOR THE COLLECTION OF THE POLLUTANTS, AND METHODS FOR THEIR ANALYSIS. TAPPI, 46(1):15-20, Jan. 1963.

A complete field kit is described and illustrated. A train of traps mounted in a portable carrying case includes an empty trap at 0 deg C. to collect moisture, an empty trap at minus 78 C. to collect high boiling pollutants, two traps containing ethylbenzene at minus 78 C. to collect pollutants other than hydrogen sulfide, and a trap containing cadmium solution for H2S. Heated glass sampling tubes convey the effluent sample to the traps. Pollutants that are quantitatively and simultaneously collected include hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. For hydrogen sulfide, an iodimetric determination is described to be made at the mill. For the other pollutants, gas chromatographic analyses are described which may be made at a later, more convenient time. (Author's abstract)

08541

Walther, James E., and Herman R. Amberg

CONTINUOUS MONITORING OF KRAFT MILL STACK GASES WITH A PROCESS GAS CHROMATOGRAPH. TAPPI. 50(10):108A-110A, Oct. 1967. 3 refs. (Presented at the 52nd Annual Meeting of the Technical Association of the Pulp and Paper Industry New York, N.Y., Feb. 1967).

A process gas chromatograph was evaluated on a recovery furnace on an intermittent basis for a period of about 3 months. The instrument was installed to obtain information about furnace operation as it relates to the emission of sulfur compounds and to determine if the process chromatograph can be used as a tool for closer control of malodorous sulfur dioxide. Fluctuations in hydrogen sulfide concentrations from 100-400 ppm by weight were recorded during normal operation of the recovery furnace. Blackouts (loss of fire) were preceded by high hydrogen sulfide concentrations. Hydrogen sulfide concentration appeared to be a more sensitive parameter of furnace operation than oxygen and combustible concentrations. It appears that the process chromatograph may be used as an indicator of furnace operation efficiency. AA

08954

Anderson, K., and J. G. Bergstrom

DETERMINATION OF HYDROGEN SULFIDE AND SULFUR DIOXIDE IN LOW CONCENTRATIONS.* (Bestaemning av svavelvaete ock svaveldioxid i laga koncentrationer.) Text in Swedish. Svensk Papperstid. (Stockholm), 70 (23):865-868, Dec. 15, 1967. 5 refs. CONCENTRATIONS. (Bestaemning av svavelvaete och svaveldioxid

A method was developed for the quantitative determination of H2S and SO2 in low concentrations (1-100 p.p.m.). The two gases are adsorbed on silica gel at room temperature and desorbed at high temperature (120-150 deg. C). The determination is done by using gas chromatography where adsorption is effected from 200-300 ml. samples. When SO2 alone is being determined, 1,500 ml. samples can be used. Since the adsorbing periods are only about 2-4 min., rapid changes in the gas composition can be followed. This method is suited for the determination of H2S and SO2 in many different types of effluents. It was success- fully used in several Swedish pulp mills. (Authors' summary, modified)

09208

National Council for Stream Improvement, Inc., New York, N. Y.

A LABORATORY STUDY OF A LEAD-ACETATE-TILE METHOD FOR THE QUANTITATIVE MEASUREMENT OF LOW CONCENTRATIONS OF HYDROGEN SULFIDE. Atmospheric Pollution Tech. Bull. 15, 47p., Aug. 1962.

A simple, qualitative method for hydrogen sulfide utilizing lead acetate on the surface of a ceramic tile was evaluated on a quantitative basis in an apparatus in which low concentrations of hydrogen sulfide were maintained. The effects of hydrogen sulfide exposure, air turbulence, relative humidity dimethyl sulfide, dimethyl disulfide, methyl mercaptan and several possible interferences upon the rate of formation of colored lead sulfide on the tile surface, were investigated. Slightly exposed tiles can show a measurable response to a hydrogen sulfide concentration of 0.1 over a 6 minute time interval. The accuracy of the lead-acetate-tile method has been found to depend upon at least three factors: (a) the position of the average absorbance of the tile surfaces on the darkening curve, (b) the degree of air movement under which the hydrogen sulfide exposure is carried out, and (c) the fading of the lead sulfide color. To establish whether or not a tile surface has been overexposed, the difference between whether or not a tile surface has been overexposed, the difference between the reflectance spectrums on the curve, may be utilized. An increase in turbulence in the laboratory detention chamber has been found to increase significantly the rate of darkening. Under outdoor conditions the turbulence level in the exposure chamber must be either standardized by an air mover or reduced to a minimum by louvering. Outdoor fading tests performed in a louvered, light-protected chamber indicate that in an 8-hour exposure period the maximum loss of Exposure Units would be in the order of 20 percent. A similar loss in Exposure Units under conditions unprotected from direct sunlight and wind would require approximately 10 minutes. The extremely high fading rate of darkening tiles exposed to direct sunlight and wind shows that hydrogen-sulfide-exposed tiles must be protected after removal from the exposure chamber as well as during exposure. The sources, effects, atmospheric concentrations and the methylene blue and A.I.S.I. sampler methods for the determination of H2S are also reviewed.

09648

Cederlof, Rune, Lars Friberg, and Thomas Lindvall

THE ORGANOLEPTIC EVALUATION OF ODORS WITH SPECIAL REFERENCE TO THE KRAFT PULP INDUSTRY. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida, DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 111-140. 16 refs.

The quantitative determination of malodorous air pollutants in ambient air is complicated by the fact that their smell becomes offensive at concentrations which are too weak for the practical analysis of shortterm measurements. Organoleptic methods have therefore been resorted to. It is of concern to be able to calculate the size and extent of an emission of odors. This is difficult because of the lack of knowledge of the identity of chemical substances in the effluent, and of the relationship between interactions of the compounds and strength of the smell. One approach is to determine the smell, either of emissions in the ambient air or of flue gases at the top of the stack in conjunction with calculations of meteorological dispersions. This would give a measure of the relevant, total exposure to odors at ground level at different distances from the source. Another method is to study the occurrence of odors in ambient air around a factory with the aid of observers. The chemical substances generally held to be responsible for the odors in the effluent are: hydrogen sulfide, methyl mercaptan, dimethyl monosulfide and dimethyl disulfide. Applications of the first approach are described presenting results of smell of some of sulfur compounds and, field studies of the flue gases from two sulfate cellulose plants in Sweden. The determination of odor threshold, as a solution to the problem, has certain obvious advantages, while studies with observations are also of value. What is wanted is a comparative study to discover the extent to which results from these two approaches agree. A lengthy discussion by one of the authors and others is appended.

09657

Hasselhuhn, B.

SAMPLING AND ANALYTICAL PROCEDURES USED IN CONNECTION WITH THE SWEDISH ODOR STUDIES. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)). p. 349-353.

The sampling methods and analytical procedures used in previous odor threshold studies for SO2, H2S, CH3SH, (CH3)2S, and (CH3)2S2 are described. The instability of some reagents is also dealt with.

09660

Walter Lenz, and Adalberto Tirado A.

METHOD OF MEASURING ODORS BY MEANS OF OBSERVERS. In: Pro- ceedings of the International Conference on Atmospheric Emis- sions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and Univer- sity of Florida. DeLand, Fla., E. O. Painter Printing Co. ((1966)), p. 365-369.

A simple method used to determine the effectiveness of the control of malodors from a kraft mill is described. A specific number of persons are asked to make a weekly report on the conditions of odor prevailing at their homes. The observers are located at different distances within a defined radius. The form delivered to the ob- server is arranged so that daily complaints can be reported for strong and slight odor, and for no odor. The form is sent to the mill where evaluation starts by completing the report with data of conditions prevailing in the mill at the time shown by the obser- ver. Next it is determined whether complaints are due to the kind of wood being cooked, to stack gases, or to improper blowing and relieving conditions. It is also decided whether or not the par- ticular complaint is justified and finally, the probable cause of the complaint is recorded. Criteria employed in the evaluation procedure are listed. The total number of weekly complaints is divided by the total number of blosw. The result is a relative index which measures the odor level. Finally the annual average of weekly relative indexes is obtained.

10453

Thoen, G. N., G.G.DeHaas, and R.R. Austin

INSTRUMENTATION FOR QUANTITATIVE MEASUREMENT OF SULFUR COMPOUNDS IN DRAFT GASES. Tappi, 51(6):246-249, June 1968. 4 refs

A recording electrolytic titrator has been evaluated in quantitative measurement of sulfur dioxide, hydrogen sulfide, mercaptan, organic sulfide, and residual sulfur concentrations. Th equipment, after slight modification, allowed rapid and reliable analysis of ambient air as well as samples drawn from draft recover furnace ducts, oxidation tower vents, and lime kiln stacks. Sample with concentrations ranging from 10 ppb to 800 ppm of hydrogen sulfide can be analyzed by selection of the proper range setting. Analysis requires 7-10 min per sample and can be conducted in the laboratory or at the point of sample collection since the instrumen is portable. (Authors' abstract)

10654

Applebury, Terrill E. and Michael J. Schaer

ANALYSIS OF KRAFT PULP MILL GASES BY PROCESS GAS CHROMATOGRAPHY. Preprint, Montana State Univ., Bozeman, Dept. of Chemical Engineering, 17p., 1968. 4 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-12.)

The operation and design of a coulometric detector for a process gas chromatograph is described. The system is suitable for monitoring kraft mill gases such as SO2, H2S, and mercaptans in concentrations as low as 0.1 to 0.5 ppm. Tests of the equipment are described with consideration given to the reduction of sensitivity by noise in the instrument; the effect of design on the noise level is also discussed.

10686

Lynch, A. J., E. J. Bowmer, A. Sykands, and J. H. Smith

DETERMINATION OF ATMOSPHERIC SODIUM IN THE VICINITY OF A DRAFT PULP MILL. Preprint, British Columbis Health Services, Vancouver, British Columbis (Canada), 14p., 1968. 8 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-120.)

A method for the determination of sodium in suspended particulate matter collected on glass fiber filters is described. Results show the variation of sodium in unexposed filters and a method to compensate for this variation is proposed. The concentrations of sodium in dustfall and suspended particulate matter in the three study areas are recorded. a draft pulp and paper mill is located in one of these areas (Port Alberni, B.C.). The results suggest that sodium may be useful index of draft mill air pollution provided a number of factors are considered. One of these factors the proximity of the station to the sea shore, is extremely impor- tant in costal locations. (Authors' abstract, modified) 10686 Lynch, A. J., E. J. Bowmer, A. Sykands, and J. H. Smith DETERMINATION OF ATMOSPHERIC SODIUM IN THE VICINITY OF A DRAFT PULP MILL. Preprint, British Columbia Health Services, Vancouver, British Columbia (Canada), 14p., 1968. 8 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-28, 1968, Paper 68-120.) EMISSION SOURCES, MEASUREMENT METHODS: Sodium compounds, Kraft pulping processes A method for the determination of sodium in suspended particulate matter collected on glass fiber filters is described. Results show the variation of sodium in unexposed filters and a method to compensate for this variation is proposed. The concentrations of sodium in dustfall and suspended particulate matter in the three study areas are recorded. A draft pulp and paper mill is located in one of these areas (Port Alberni, B. C.). The results suggest that sodium may be useful index of draft mill air pollution provided a number of factors are considered. One of these factors, the proximity of the station to the sea shore, is extremely important in costal locations. (Authors' abstract, modified)

14582

Harkness, A. C. and B. A. Kelman

SOLUBILITY OF METHYL MERCAPTAN IN WATER. TAPPI, 50(1):13, Jan. 1967. 6 refs.

The solubilities of methyl mercaptan and H2S in water were determined by measuring the volume of gas absorbed at constant pressure. The solubility of methyl mercaptan was found to be proportional to its pressure up to 700 mm, the highest pressure used. At 30 C, its solubility is found to be 4.90 vol/vol/atm and that for H2S, solubility is 1.86. The heat of solution of methyl mercaptan is calculated to be -6.2 kcal/mole and its solubilities in 0.05M H2SO4, 1M H2SO4, 0.1M NaSCH3, 1M NaC1, and 1M Na2SO4 are, respectively, 5.06, 4.29, 5.29, 3.94, and 2.24 vol/vol/atm.

15224

Sanderson, J. G. and A. J. Roy

MEASUREMENTS AND SAMPLING OF AIR POLLUTANTS FROM A KRAFT MILL. Pulp Paper Mag. Can. (Quebec), 70(21):85-90, Tech. Paper T404, Nov. 7, 1969. 12 refs. (Presented at the 55th Annual Meeting of the Technical Section, Canadian Pulp and Paper Assoc., Montreal, Que., Jan. 28-31, 1969.)

Grab and continuous sampling methods for measuring emissions of particulate and gaseous pollutants from kraft mills are reviewed. In the grab method of particulate sampling, a sample of gas containing the entrained particulates is withdrawn through a probe inserted in the gas duct; the same gas velocity as in the duct must be maintained through the probe (isokinetic sampling). A sampling train assembly for unsaturated gas streams and the preferred types of filters are described. Sampling of saturated gas streams is much more difficult but less imperative for pollution control. Continuous methods of particulate sampling include use of a bolometer, which continuously measures the fraction of light that has penetrated or has been absorbed by a path of stack gas at a given distance from a light source of constant intensity, and continuous salt cake monitors. Both methods, in their present development, are considered best used as control instruments and as tools for showing visual indication of upset conditions in an electrostatic precipitator. Correlation to date with grain readings has not been sufficiently good to obviate the need to sample the stack. In gas sampling, bench gas chromatographs with flame ionization and thermal conductivity detection methods are probably the most reliable and versatile means of measuring the concentration of reduced sulfur gases from grab samples taken at the emission sources. In-line gas chromatographs, the Murray sulfimeter, and the Barton titrator are described as methods of continuous gas sampling. It is concluded that the fairly recent introduction of continuous methods of sampling and measurement of particulates and gases emitted from the recovery furnace will provide valuable information for combating pollution from this source, and, when fully developed, will overcome many of the problems inherent in grab sampling methods.

15704

Leahy, T. E.

DETERMINATION OF GASES FROM VISCOSE REGENERATION. Tappi, 52(1): 115-117, Jan. 1969. 3 refs.

A method for the qualitative detection and quantitative estimation of volatile substances evolved during the regeneration of viscose has been developed. The method involves use of conventional methods of analysis as well as the gas chromatograph for the separation of several of the components normally evolved. The methods, as described, have reasonable accuracy and reproducibility based on the use of known standards for calibration. Several series of laboratory prepared viscoses have been studied in an effort to determine the effect of pre- and post-xanthation conditions on the amounts and types of gases evolved during viscose regeneration. An example of a viscose from the crumb stage through ripening is also given. (Author's Abstract)

16577

Ries, E. D. and L. E. Clark

ANALYSIS OF SULFUR DIOXIDE IN THE PRESENCE OF EXCESS AIR. Ind. Eng. Chem., vol. 18:747, July 1926. 2 refs.

Various methods for determining of small amounts of sulfur dioxide in air were tested. Triple-distilled sulfur dioxide, dried with concentrated sulfuric acid, and air of known, low humidity were used for the tests. All methods were compared on an absolute basis. Absorbents tried were solutions of iodine in potassium iodide, sodium peroxide, sodium hypochlorite, alkaline iodine, alkaline potassium permanganate, acid potassium dichromate, iodine plus sodium bicarbonate, sodium hydroxide, sodium hydroxide plus 5% glycerol, sodium hydroxide plus 50% glycerol, sodium hydroxide containing 0.001 mol stannous chloride per l, and sodium hydroxide containing 0.002 mol stannous chloride per l. Solid lead peroxide and a water suspension of solid lead peroxide were also tried. The sodium peroxide and sodium hydroxide plus glycerol or stannous chloride were the only methods which gave satisfactory results. The following method was adopted. Sulfur dioxide is absorbed by bubbling the gas through 10 cc of 10% sodium hydroxide solution, 0.002 M in stannous chloride, contained in a modified 4-bulb Mitscherlich absorber. The solution is then washed into a flask, diluted to 50 cc, cooled, 50 cc of 12 N hydrochloric acid added, the solution cooled again, and 2 cc of carbon tetrachloride added as an indicator. The solution is then titrated with approximately 0.003 M potassium iodate. The flask is shaken vigorously during the titration until the pink color of the carbon tetrachloride disappears. A blank must be run on the caustic plus stannous chloride to determine the correction for the catalyst. This analysis is important for control work in commercial processes, such as contact sulfuric acid and paper manufacture.

16755

Bamesberger, W. L. and Donald F. Adams

FIELD COMPARISON OF THE COULOMETRIC, COLORIMETRIC, AND LEAD ACETATE TAPE ANALYSIS METHODS FOR SULFUR-CONTAINING GASES. Tappi 52(7):1302-1306, July 1969. 15 refs.

A continuous, microcoulometric analyzer, utilizing preselective filtration, has been used for a field study of the varying atmospheric concentrations of sulfur dioxide, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide in the vicinity of a kraft pulp mill. The microcoulometric analyzer was operated on a 5 min sequence for each of the five sulfur-containing compounds and a 5 min instrument blank, thereby yielding a complete analysis cycle every 30 min. Another coulometric analyzer with lower sensitivity was used as a a total sulfur gas analyzer. Comparative 2-hr average data were obtained for H2S and SO2 by using midget impingers in a sequence sampler. Chemical analyses were conducted by the cadmium hydroxide---STRactan---methylene blue and modified West-Gaeke methods, respectively. A third comparison for H2S was obtained by using the lead acetate tape method. The data show agreement for H2S by the microcoulometric and cadmium hydroxide---STRactan---methylene blue methods but not with the lead acetate tape technique. Agreement was also obtained for SO2 by the microcoulometric and modified West-Gaeke methods, although all observed SO2 levels were near the sensitivity limits for these methods. (Author's Abstract)

16871

Thoen, G. N., G. G. DeHaas, and R. R. Austin

CONTINUOUS MEASUREMENT OF SULFUR COMPOUNDS AND THEIR RELATIONSHIP TO OPERATING KRAFT MILL BLACK LIQUOR FURNACES. Tappi, 52(8): 1485-1487, Aug. 1969. 4 refs.

A continuous instrument has been designed and built to measure sulfur dioxide and reduced sulfur compounds in the parts-per- million and parts-per-billion ranges. The instrument has been placed in operation on several black liquor recovery furnaces before the direct contact evaporator. Operation parameters under most possible conditions have been measured and correlations between sulfur dioxide and reduced sulfur compounds have been made. Steam production and degree of smelt reduction have also been determined in relation to the concentrations of the sulfur compounds. (Author's Abstract)

17029

Applebury, Terrill E. and Michael J. Schaer

ANALYSIS OF KRAFT PULP MILL GASES BY PROCESS GAS CHROMATOGRAPHY. J. Air Pollution Control Assoc., 20(2):83-86, Feb. 1970. 4 refs.

An automatic process gas chromatograph was developed for use on the recovery furnace stack of a Kraft pulp mill. The instrument analyzes widely varying concentrations of hydrogen sulfide, sulfur dioxide, and methyl mercaptan, and higher order sulfur compounds. It is insensitive to the fixed gases and water vapor, and performs its analysis in approximately ten minutes. The instrument features a microcoulometric detector making it sensitive to H_2S as low as 0.1 ppm, and SO_2 and CH_3SH as low as 0.5 ppm. The major limit to even higher sensitivity at this stage of development lies in two problems: the background noise level in the detector and the sulfur compound absorption in the Porapak Q chromatograph column. At the reported sensitivity, a 40-ml gas sample was used. The instrument also contains a data analysis system supplementary to the usual strip chart recorder. This system is made up of a digital voltmeter, a digital translator, and a teletype and hence allows the transfer of the output data to a digital computer for processing. The processed data are usually presented in the form of ppm quantities of the component gases in the stack gas. The instrument has worked successfully on small furnace effluent for periods of 25 hr but has not been tried on recovery furnace stacks. It was also run on prepared samples for periods of up to seven days with no maintenance or attendance necessary. (Author abstract modified)

17037

Thoen, G. N. and D. C. Nicholson

INFRARED ANALYSIS OF KRAFT PULPING PROCESS GASES. Tappi, 53(2):224-226, Feb. 1970. 3 refs.

Investigations were undertaken to determine the suitability of an infrared spectrophotometer equipped with 10-m path length cells for analyzing kraft pulping gases. Components present in black- liquor recovery furnace, oxidation tower vent, lime kiln, evaporator, and digester relief and blow gases were identified positively without pretreatment of a mixture. However, infrared scanning still presents the problem of sample preparation and transport. Other methods such as coulometric titration or gas chromatography seem best suited for mill use.

19051

McGinnity, J. L., K. W. Grimley, Jr., C. R. Horres, Jr., and J. D. Mulik

MOBILE SOURCE SAMPLING LABORATORY FOR THE PULP AND PAPER INDUSTRY. Preprint, Public Health Service, Durham, N. C., National Air Pollution Control Administration, 12p., 1970. 7 refs. (Presented at a Symposium on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, June 1-5, 1970.)

A mobile source-sampling laboratory for the pulp and paper industry is discussed. A continuously operating stack-gas- conditioning system has been devised for the laboratory. From the source, the gas sample first passes through a heated glass-fiber filter to remove particulates, and then into a 3/16-inch-ID Teflon sampling line. The continuous gas monitoring instruments provide analysis for oxygen, carbon monoxide, carbon dioxide, hydrocarbons, and various sulfur compounds. Seven instruments are used: two gas chromatographs, a Melpar total sulfur analyzer, a Barton titrator, and a Beckman O_2, CO_2, and CO analyzer. Another part of the source sampling program is an odor panel. Samples are diluted in 100 ml syringes and presented to the panel directly from the syringe. Emission data are available for gas samples taken before and after the direct contact evaporators, recovery furnace precipitator, smelt dissolving tank, lime kiln scrubber, and multiple effect evaporator scrubbers.

20435

Choudens, C. de

DETERMINATIONS OF SULFUR DIOXIDE AND HYDROGEN SULFIDE BY SPECTROPHOTOMETRY IN GASEOUS EFFLUENTS OF RECOVERY CALDRONS OF A SULFATE PASTE PLANT. (Dosages de l'anhydride sulfureux et de l'hydrogene sulfure par spectrophotometrie dans les effluents gazeux de chaudieres de recuperation d'une usine de pate au sulfate). Text in French. ATIP, 22(2):113-121, 1968. 18 refs.

A method of removing and recovering gas samples in the flue gas of a recovery caldron in a sulfate paste plant was put in operation and found to work very satisfactorily, provided certain precautions described in the paper are taken. The gases withdrawn from the sampling devices are free from solid particles and moisture and are absorbed by a soda-glycerol solution for spectrophotometric determination of sulfur dioxide and hydrogen sulfide. The accuracy of this determination is 1%, provided the operator is well trained and the specified procedure is rigorously adhered to. If calibration curves have been determined with the aid of control solutions; if the reagents, are ready for use; and if the speed of the gas in the flue is known, one should have all results available within two hours. The colorimetric reagents used are quite specific at the concentrations of constituents studied. Methylmercaptan does not perturb the spectrophotometric determination of H_2S. The latter is determined directly by measuring the optical density at 680 nanometers, while the concentration of methylmercaptan is usually determined (after precipitation of H_2S by $CdCl_2$) by measuring the optical density at 515 nanometers. The accuracy of the described method of SO_2 and H_2S determination is 10%.

21724

Hendrickson, E. R., J. E. Roberson, and J. B. Koogler

CONTROL OF ATMOSPHERIC EMISSIONS IN THE WOOD PULPING INDUSTRY. VOLUME 3. (FINAL REPORT). Environmental Engineering, Inc., Gainesville, Fla., and Sirrine (J.

E.) Co., Greenville, S. C., Contract CPA 22-69-18, 250p., March 15, 1970. 418 refs. CFSTI: PB 190353

Chapters 9 through 13 are contained in this third and final volume of a study of control of wood pulping emissions. Chapter 9, which includes 237 references, reviews sampling and analytical techniques, grouped under emission source or ambient conditions, for kraft, sulfite, and NSSC pulping processes. For each grouping, recommendations are made of the best available procedures. An annotated bibliography of 174 papers related to on-going research in pulping emissions control comprises Chapter 10; references are grouped under eight subjects. Recommendations for future research and development are made in Chapter 11. Chapter 12 presents estimates of present pulping industry investment and operating costs for emissions control. The cost analyses are based on prices of chemicals and equipment as of Jan. 1969. Chapter 13 reports the development of a model which provides data applicable for projections of investment and operating costs for emission control in the kraft pulping industry through 1980. A sensitivity analysis suggests how the costs for emission control are influenced by emission standards,value of recoverable chemicals, and assumed rate of return. A mathematical programming model is also presented, by which it is possible to determine for any specified mill the optimal way to satisfy specified emission standards and maximize net revenue from emission control. An an example is analyzed with the model, using the 1969 Oregon regulations and based on Jan. 1969 prices.

21859

Okita, T., R. Sugai, and I. Kifune

SAMPLING AND ANALYSIS BY FILTER METHOD OF MALODOROUS GASES IN THE ATMOSPHERE. (Akooshu no sokootei V Loshishiki sampler ni yoloo yuki ioh kagohbootsoo no hoshu boonsekihon no kentoh narabini ryukasooiso oyohi aldehyde rooi sokootei eno ohyoh). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):118, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

To determine malodors in the environment, filter type sampler for sampling organic sulfur compounds using mercury compounds was earlier introduced. Since then, the following items on sampling and analysis, by means of gas chromatography, of ethyl mercaptan, methyl mercaptan, and dimethyl sulfide were examined. In the process of the analysis (sampling, separation, and concentration), moisture should be removed before concentrating the sample with potassium carbonate and soda lime. The velocity in concentrating the sample with liquid oxygen is 0.2 l/min. The retention time of each sample gas can be remarkably reduced if the column temperature is 47 C, the flowrate of a carrier gas (N_2) 30 l/min, and the column length 2.25 m. The reproducibility of this method is approximately 6% in terms of variation coefficients. Filters compared (Tohyoh No. 6 filter, AAWP millipore filter, and glass fiber A filter) show the collection efficiency from 44% to 100%, depending on the gases. This method is applied for gases in the water and the air polluted by waste from pulp and petroleum refining industries to show 6.0-7.8 ppb of methyl mercaptan, 2.9-3.7 ppb ethyl mercaptan, and 5.1-7.2 ppb of dimethyl sulfide in river water and 4.0-5.2 ppb of methyl mercaptan and 2.3-3 ppb dimethyl sulfide in the air.

22958

Wohlers, Henry C.

ODOR INTENSITY AND ODOR TRAVEL FROM INDUSTRIAL SOURCES. Intern. J. Air Water Pollution (London), vol. 7:71-78, 1963. 4 refs.

Odor surveys were completed of stack effluents and in the vicinity of a petroleum coking plant, a kraft-paper mill, an onion and garlic dehydrating plant, and a retrogravure printing plant. Gas samples were taken by the evacuated bulb technique or by passing sufficient stack gas through a bottle to replace the original air in the bottle. Threshold measurements were made with an osmoscope consisting of two telescoping metal tubes complexly arranged for odor dilution with clean air. The odor intensity in the environs of the industrial plant was determined subjectively while driving in a car at constant speed (30-35 mph) with the wind-wing of the driver's window open so that the oncoming air was directed at the face of the observer. When the extent of the odor travel from these plants was compared with the calculated threshold dilution of the stack gases according to Sutton's equation, the odor measurements at the stacks did not agree in all cases with the calculated dilutions at the distances in the field where the odors were noted. Unless the diffusion coefficients are experimentally determined, the Sutton equation should not be used for distances greater than 2 miles; at distances greater than 1 or 2 miles under unstable conditions, the stack height, the exit velocity, and the temperature of the exhaust gases no longer seriously affect the plume axis concentrations. The osmoscope, which assumes the validity of the Weber-Fechner law, had an error of no larger than about 25%. The consequence of the logarithmic relation of this law is that a 10-fold reduction in odor concentration makes a scarcely perceptible alteration in the strength of the odor. This relation must be considered in making field odor surveys. It is suggested that these results are another example of only partially diluted stack gases moving as discrete eddies through the atmosphere. (Author abstract modified)

23106

Kikuchi, Kaku

EXAMPLES OF ODOR MEASUREMENT AT KRAFT PULP MILLS. (Kurafuto parupukojo no shukisokutei jirei). Text in Japanese. Akushu no Kenkyu (J. of Odor Control), 1(1):9-18, April 20, 1970.

A unique method of measuring odorant concentration developed at Tohoku University. This is a new type of organoleptic method based on the olfactory reaction to determine odor perception thresholds which are numerically expressed. It is also noteworthy that this method is legally authorized to be the only valid means of odor measurement and to be employed as such for air pollution control. The flowchart of the apparatus used for the olfactory test as well as the present odor removal equipments which the kraft pulp mills are operating are illustrated. The principle of this method is based on Henry's law that a gas is saturated in proportion to its partial pressure in the atmosphere after it has been passed through water for a while. The maximum dilution multiplier for the saturated solution which is determined by olfactory sense provides the standard for the obnoxious odor level. The sampled gas needs to be passed through the duct filled with salt water until the concentration of the gas arising from the salt water becomes tantamount to its original level in the atmosphere. The sample solution thus obtained have to be promptly examined by an odor panel because some gases dissolve very readily. The application of this olfactorium to gaseous emissions from both the blow tank and the recovery boiler in a kraft pulp mill was made, and the values obtained showed 700 and 200 respectively. The basic value of 200 was determined from a fish-meal factory). The results of tests conducted on each one of the processes involved in kraft pulp mills by use of this salt water olfactorium are presented in the form of graphs and tables.

23278

Lindvall, Thomas

ON SENSORY EVALUATION OF ODOROUS AIR POLLUTANT INTENSITIES. MEASUREMENTS OF ODOR INTENSITY IN THE LABORATORY AND IN THE FIELD WITH SPECIAL REFERENCE TO EFFLUENTS OF SULFATE PULP FACTORIES. Nord. Hyg. Tidskr. (Stockholm). Suppl. 2, 181p., 1970. 145 refs.

A primary concern in the investigation of the environmental hygienic annoyance effects of odorous air pollutants is to establis a relationship between the dose to which the population is exposed and the degree of annoyance experienced. The present study describes a method for sensory analysis of odor intensities of air pollutants, primarily as a base for a valid dose-description. The work was concerned with the air conservation problems of the sulfate pulp industry from the standpoint of environmental hygiene and was primarily aimed at the development of a method to study the relative importance of various odor generating processes in regard to the final odor intensity of the emissions, to study the effects of various types of odor-reducing systems, to predict odor distribution in the vicinity of a factory on the basis of odor determinations of the emitted exhausts and meteorological dispersion data, and to study the feasibility of predicting exhaust gas odor intensities from their physicochemical composition. A mobile odor laboratory for field experiments was constructed with the purpose of obtaining a standardized experimental environment independent of the location of the laboratory and the presence of odors in the vicinity. The equipment permits the determination of absolute odor threshold, signal detectability as well as supraliminal odor intensities of both simple and complex exhausts. A practical and economical variant of an ascending method of limit with paired comparisons was tested and found suitable for determining the absolute threshold for both individuals and groups of subjects. Due to the wide stimulus range, the method is readily adaptable to variations in individual odor sensitivity and in the intensity of the test gases. The influence of context in sensory analyses was studied with reference to the effects of adaptation, motivation, practice and certain biological variables. The consequences of these investigations with regard to the construction of the experimental equipment and the method are discussed.

24939

Kesler, Richard B.

MODERN METHODS OF MONITORING GASEOUS PULP MILL EFFLUENTS FOR SULFUR COMPOUNDS. Advan. Automated Anal., 1970:111-114. 30 refs (Presented at Technicon International Congress on Automated Analysis, Chicago, Ill., June 4-6, 1969, Paper 691-52.)

A search of technical and manufacturers' literature was undertaken to discover and assess recent methods and instruments used to monitor gaseous pulp mill effluents for sulfur compounds. The compounds of interest are sulfur dioxide, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. The accuracy, sensitivity, selectivity, cost, maintenance, and suitability for long-term monitoring with respect to response time, stability, and frequency of service required is evaluated for each of the following methods: colorimetry, coulometry, direct spectrophotometry, and gas chromatography. Colorimetric and gas chromatographic methods seem applicable mainly when an occasional manual analysis is to be made. Coulometric devices offer specificity, sensitivity, and capability for long-term continuous monitoring with remote read-out, while direct spectrophotometry, particularly for the infrared and ultraviolet determination of SO2, is perhaps the most simple and suitable method for long-term, quick-response monitoring.

25466

Lindvall, Thomas

SWEDISH EXPERIENCES ON SENSORY EVALUATION OF ODOROUS AIR POLLUTANT INTENSITIES. Preprint, International Union of Air Pollution Prevention Associations, 34p., 1970. 15 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper SU-18A.)

A primary concern in the investigation of the environmental hygienic annoyance effects of odorous air pollutants is to establish a relationship between the dose to which the population is exposed and the degree of annoyance experienced. A method for sensory analysis of odor intensities of air pollutants was developed, primarily as a base for a valid dose-description. Field studies were conducted using mobile odor laboratories providing standarized experimental environments independent of the location of the laboratories and the presence of odors in the vicinity. Sensory source intensity analysis at a sulfate pulp factory combined with meteorological calculations were used to predict the frequency with which odor would be discernible in the ambient air at various distances from the source. Reports made under controlled conditions by special observers display a strikingly high degree of correlation with the predictions of odor frequency in the observation area up to at least 5 km from the source. Such predictions have been used to estimate the consequences from an environmental hygienic standpoint of a planned pulp mill in a resort area in Sweden. Determinations of absolute odor thresholds were conducted at various process stages in the sulfate pulp and rock wool industries. Effects of various countermeasures have been studied and an effort has been made to correlate the chemical composition of the sulfate exhausts with their odor intensity measured by absolute odor threshold methods. The sensory method of analysis developed has displayed great applicability also for studies of exhausts from motor vehicles, combustion units, and in the handling of animal wastes. (Author abstract)

27069

Colombo, Pietro, Davide Corbetta, Alessandro Pirotta, and Alberto Sartori

CRITICAL DISCUSSION ON THE ANALYTICAL METHODS FOR MERCAPTAN AND SULPHUR COMPOUNDS. TAPPI, 40(6):490-498, June 1957. 10 refs.

After a short discussion on a number of analytical methods, already published for the determination of sulfurous gases from a Kraft pulp mill, a new method is proposed for the analysis of combustion gases from a recovery furnace. The sample is absorbed through a 0.2 N sodium acetate solution, where sulfur dioxide reacts quantitatively. Then hydrogen sulfide is precipitated as cadmium sulfide from a 5% cadmium chloride solution at pH 1. Finally, methylmercaptan is absorbed quantitatively in methyl alcohol chilled to -75 C. The analysis of sulfur dioxide is carried out by oxidation of the sodium sulfide solution to sulfuric acid and gravimetrically determined; methylmercaptan and eventual traces of hydrogen sulfide are potentiometrically titrated with a silver nitrate 0.01 N solution. The threshold for the detection of methylmercaptan is around 10 mg/cu m or 5 ppm; a precision of 20% is obtained at a level of 20 mg/cu m, the precision increases at higher mercaptan's concentration. (Author abstract modified)

27355

Shigeta, Yoshihiro

ODOR POLLUTION IN THE CHEMICAL PLANT AND ITS MEASUREMENT METHOD. (Kagaku kojo ni okeru akushu-kogai to snon sokuteiho). Text in Japanese. Anzen Kogaku (J. Japan Soc. Safety Eng.), 9(1):20-28, Feb. 1970. 19 refs.

Sources of odor pollution include petroleum refinery, petrochemical and kraft pulping industries. Direct consequences of odor pollution depend on the pollutant. Hydrogen sulfide and mercaptans are malodorous and chlorine, acrolein, and ammonia are stimulants. The former induce headaches and sick feelings, while the latter attack eyes and throat. Indirect damages are deterioration of property, soiling, and loss of business. The damages extend to an average of 100-200 m downwind from the source, and in some cases extend as far as 4 km or even 7 km. The definition of malodorous gases is difficult, because they cannot be categorized by the industries or processes, or by harms done on the human body. Here the definition bad odor is 'odor that disgusts people' and malodorous substance is gaseous substance, sometimes containing mists and particulates, that induce disgust through olfaction. In Japan odorimetry involves odorless chamber, syringe, or Kinoshita-type (salt solution equilibrium) methods. There is also gas-chromatography such as low-temperature adsorption, vacuum bottle, or solid reactor tube methods. Methods in the U. S. include dilution by air, chemical analysis, and mechanical analysis methods. The continuous (dynamic) method falls into the category of air-dilution and uses an olfactometer or scentometer together with an odor panel. The odor panel must possess the following qualities: discrimination ability, pertinence, stability, and ability to express.

28489

ISOTOPES AND RADIATION: NUCLEAR TECHNIQUES IN ENVIRONMENTAL POLLUTANTS CONTROL-I. Trans. Am. Nucl. Soc., 11(1):50-51, June 1968.

Summaries are presented of papers on nuclear techniques for water pollution control in Sweden, detection of pollutants in airborne particulates by activation analysis, the application of radioisotop techniques to stream pollution problems in the pulp and paper industry, and Krypton (85) measurement of stream re-aeration rates. In Sweden, nuclear analytical techniques are used to measure the flow rate of industrial effluent, the dispersion of effluent in various receivers, (rivers, lakes, the sea), and to determine the mercury content of natural waters. In Toronto, levels of 13 trace components of airborne dusts were obtained by activation analysis. Iridium as ammonium chloroiridate can be used as a nonradioactive tag in tracing pulp and fines through paper mill lines. Accurate, direct measurements of stream re-aeration capacity are now possibile with a Krypton (85) tracer method. Such measurements will provide the necessary basis for accurately determining waste treatment requirements and costs.

28708

Thoen, Gerhardt N.

GAS SAMPLING PROBE. (Weyerhaeuser Co., Tacoma, Wash.) U. S. Pat. 3,559,491. 3 p., Feb. 2, 1971. 7 refs. (Appl. March 10, 1969, 10 claims).

A probe is disclosed for sampling particulate and moisture-laden gases, especially those from combustion furnaces such as black liquor recovery furnaces, power boilers, and lime kilns. The probe is much simpler than known gas sampling apparatus, has fewer parts, and is capable of operating efficiently over extended periods of time. The probe comprises a tubular shield having an open end in the gas flow path and a tubular sampling probe mounted concentrically within the shield. The probe is made of low heat conductive subtance permeable to moisture. Particularly useful are ceramic materials. The probe allows moisture to evaporate through it to the atmosphere, cools the gas sample without degradation of its contents, and is corrosion resistant. Particulate matter which deposits in the probe is removed periodically by flushing the tubular probe with compressed air or other fluid. Valve means periodically and selectively connect the flushing fluid to the probe. (Author abstract modified)

29072

Pilat, Michael, J., David S. Ensor, and John C. Bosch

SOURCE TEST CASCADE IMPACTOR. Atmos. Environ., 4(6):671-679, Nov. 1970. 24 refs.

A description is given of a source test cascade impactor for measuring the size distribution of particles in stacks and ducts at air pollutant emission sources. The impactor is operated inside the stack or duct to achieve true isokinetic sampling with a minimum of wall losses and condensation problems. The impactor includes seven stages (a single inlet jet stage, six multi-jet stages) followed by a filter. The single jet of the inlet nozzle (first stage) eliminates the problem of particle loss on the top of the first multi-jet stage. One eighth in. high rims around the parameter of the plates prevent particles from falling to the wall. The source test impactor has been used to measure the size distribution of particles emitted by a coal-fired power boiler, a kraft pulp mill recovery furnace, and a plywood veneer drier. Particle size distributions measured at the power plant and kraft recovery furnace are presented.

29726

Baba, Yoshio

ON MEASUREMENT OF ODOR. (Shuki no sokuteiho ni tsuite). Text in Japanese. Kogai (Hakua Shobo) Pollution Control, 6(1):50-56, Jan. 1971.

In a bill to control obnoxious odors, methylamine sulfide, methyl mercaptan and ammonia and industries such as the livestock farms, food processing, garbage treatment, and pulp manufacturing are the objects for possible control. However, although the refinery and pulp mill both emit obnoxious odors of a sulfur origin, the odor from the steaming pot of the kraft pulp mill is mostly methylmercaptan; from refinery, dozens of sulfur compounds are emitted, not just methylmercaptan. If the concentration of methylmercaptan alone is to be the measured, because the concentration of methylmercaptan from refinery is so small, the kraft pulp mill would be placed at a disadvantage. In all fairness the total amount of sulfur should be added. Based on the ASTM, the sensory test is used for the measurement of odors. In Japan, the air dilution method (olefactometer method), the pressure ratio method, salt balance method, and odorless chamber method are used. The balance method is simple to handle and is the most widely used. The weakness of the sensory method is that it cannot be used for continuous measurement of air pollutants. In using instrumental measurements, there is a problem of detecting small amounts of odor constituents and relating the intensity of the odor suffered by the people to the components of the odor. Man can detect 0.1-0.005 ppm of hydrogen sulfide and 0.01-0.0001 ppm methylmercaptan, which is difficult to measure with instruments. However, there are gas chromatographs which are very sensitive, measuring 10 to the minus ninth g. Selective use of the gas chromatograph with an adequate trapping method must be made. A method for the extraction of odor components is also described.

29913

Mulik, J. D. R. K. Stevens, and R. Baumgardner

AUTOMATED ANALYSIS SYSTEMS MAKES KRAFT EMISSION MEASUREMENTS EASY. Paper Trade J., 155(16):46, April 19, 1971. (Presented at the American Chemical Society Meeting, 157th, Minneapolis, Minn., April 1969.)

Gas-chromatographic-flame photometric analyzers were developed to measure both low-molecular weight and heavier sulfur compounds in air emissions from kraft mills. The analyzer for the lighter compounds has a 10-part sliding valve equipped with a 10-cc Teflon sample loop, a 2-ft stripping column, and a 36-ft analytical column. Both columns are Teflon tubes packed with mesh Teflon and coated with polyphenyl ether and orthophosphoric acid. Automatic actuation of the valve at 10-min intervals is done with solenoids and a cam timer. Hydrogen sulfide, sulfur dioxide, methyl mercaptan, ethyl mercaptan, dimethyl sulfide, and propyl mercaptan are resolved in 10 min by the analytical column. A total sulfur analyzer incorporates a 6-port sampling valve. The analytical colum is a 10-ft Teflon tube packed with mesh Teflon and coated with Triton-X 305. The lighter sulfur compounds emerge rapidly from this column, followed by heavy sulfur compounds that elute separately. The second analyzer was used to measure emissions at a kraft mill employing the strong black liquor oxidation process and at another mill employing the weak oxidation process. At both plants, sulfur dioxide and hydrogen sulfide were found to be the major pollutants emitted.

30202

Brink, D. L., A. A. Pohlman, and J. F. Thomas

ANALYSIS OF SULFUR-CONTAINING AND SULFUR-FREE ORGANIC PRODUCTS FORMED IN KRAFT BLACK LIQUOR PYROLYSIS. Tappi, 54(5):714-720, May 1971. 8 refs.

A dual flame ionization-microcoulometric titration system was designed and used to detect all organic compounds and sulfur-containing organic compounds, respectively, as these kraft black liquor pyrolysis products were eluted from a gas chromatograph. A sulfur specific detector in a gas chromatographic system is needed for the analysis of such mixtures. A preparative gas chromatographic system was used to isolate the major pyrolysis products in sufficient purity to permit subsequent analytical studies by mass spectrometry. The compounds identified include: methyl mercaptan, dimethyl sulfide, dimethyl desulfide, benzene, toluene, xylenes, phenol, anisol, cresols, and xylenols. The identification of additonal sulfur-containing compounds required the development of a fractionation technique designed to isolate these products from the sulfur-free components, which are present in substantially higher concentrations. The technique developed was shown to be effective by the dual FID-MCT chromatographic system. The separated sulfur-containing products were then isolated in sufficiently pure form to permit mass spectrometric studies. Some preliminary results of these studies are reported. The effect of temperature on the formation of pyrolysis products is also shown by using the dual chromatographic system. (Author summary modified)

30263

Austin, R. R.

SAMPLING AND ANALYSIS OF PULP MILL GASES FOR SULFUR COMPOUNDS. TAPPI, 54(6):977-980, June 1971. 6 refs.

The analysis of black liquor recovery furnace stack gas is now an important source of data to the pulp mill. Continuous sample methods and equipment have been developed and proved practical in routine operation by mill operating personnel. Problems of particulate rejection and moisture consideration have been solved by high-temperature filtration in the stack, and in some sample systems blow back of purge is through the sample probe. Analysis by continuous sampling and electrolytic titration (coulometry) using automatically cycled wet scrubbers for sulfur dioxide removal, provides concentration data for hydrogen sulfide and total sulfur. These data are useful in furnace control and in monitoring emissions from the stack. (Author abstract)

32467

Takagi, Sadayoshi, Tatsuo Kato, Tsugio Sawatani, Akio Tsuji, Hidetsuru Matsushita, and Takeo Miura

STUDY ON MAL-ODORS IN AIR POLLUTION. (INTERIM REPORT). (Akushu kogai ni kansuru kenkyu. (Chukan hokoku)). Text in Japanese. Study Group on Bad Odors (Japan), 42p., March 1970.

Problems pertaining to foul odors are difficult to solve or to quantitatively measure, since in perceiving them psychological aspects are involved. Characteristics, types, concentrations, and effects of odors on the physiological function of experimental animals are considered. An analytical method which utilizes gas chromatography and low-temperature condensation is described for measuring odors. Dry ice or liquid oxygen is used to adsorb the malodorous substances on diatomaceous refractory brick particles or glass beads at low-temperature. Substances used for comparison are generally mercaptans, sulfides, amines, aldehydes, or chlorides. Experiments were conducted at oil refineries, fish processing plants, and pulp mills. Another method involves solid reaction in a tube, and has a number of advantages such as moderate costs and easy preparation.

32880

Hoshika, Yasuuki

CORRELATIVITY BETWEEN SOME ODOR MEASUREMENT METHODS USED IN ODOR SURVEY. (Akushu kogai chosa ni okeru 2-3 no shuki sokuteiho no sokanei. Text in Japne. osu o Hi(J. Water Wste, 13(:-1,Au. 1971.

A study was performed to correlate data obtained by olfactory test (ASTM syringe method) and gas chromatography. The relation between the potential of the offensive odor and the detected density of each component causing the odor was established based on the assumptions that the dilution process caused neither mechanical nor chemical errors; the olfactory sense (olfactory, discrimination, and odor threshold values) was stable and reproducible; and no chemical reactions and multiplication or offsetting of the odor take place among the odorous components. The relation between the odor dilution ratio and the detectable and olfactory threshold values of each odorousct was estimated nd applid t o ather processi la, amin acid manufactig plat, ad a kraft pulping plant. The olfactosensdetermined methyl mercaptan in the kraft pulping plant, acrolein in the feather processing plant, and ammonia, acrolein, and methyl mercaptan in the amino acid plant as the strongest odorous components.

33045

Triplett, Gary

ESTIMATION OF PLANT EMISSIONS. Preprint, p. 15-27. 1970 (?). 21 refs.

There are times when it is not possible or practical to determine emission rates by stack sampling; in these cases emission rates may be estimated by utilizing available emission factors. An emission factor is the statistical average of the mass of contaminants emitted/unit quantity of material handled, processed, or burned. The emission factor may also be expressed as the quantity of contaminant/unit quantity of final product or effluent volume. These factors have been developed through stack testing or by material balance calculations. Emission factors are normally given in terms of uncontrolled emissions. Therefore, the type and effectiveness of control equipment must be considered when calculating emissions from controlled sources. Particle size distribution and effective stack height should also be considered. Emission factors are given for coal, fuel oil, natural gas, and wood burning; solid waste disposal; incinerators; paint manufacturing; the food and agriculture industry; primary metallurgical processing including iron and steel manufacturing, open hearth furnaces, basic oxygen furnaces, electrical arc furnaces, and blast furnaces; smelting and foundries for aluminum, brass, lead magnesium, steel, and zinc; mineral processing of asphalt, calcium carbide, cement, concrete, glass and lime; petroleum production, and the kraft pulp industry. (Author abstract modified)

33055

Mott, W. E.

ISOTOPIC TECHNIQUES IN THE STUDY AND CONTROL OF ENVIRONMENTAL POLLUTION. International Atomic Energy Agency, Vienna (Austria), Nucl. Tech. Environ. Pollut. Proc. Symp., Salzburg (Austria), 1970, p. 3-46. 151 refs. (Oct. 26-30, Paper IAEA-SM-142a/1.)

Work performed with isotopes in the environmental pollution area in the United States is identified and described for the last five years. Applications of activable tracers and isotope ratio techniques to the dispersion and fate of oxides of sulfur, miscellaneous gases and aerosols, and ground-level distributions of emissions are considered. Tracer studies have been made of municipal wastewater treatment and discharge, viruses and bacteria in wastewater effluents, refinery effluents, pulp and paper mill effluents, oil spillage, agriculture wastes, transfer of pollutants in ecosystems, and the movement of sediments. Radioisotope instruments include the strontium-90 ozone generator, turbidity monitor for water treatment plants, density gages in wastewater treatment plants, automated primary productivity instruments, an eggshell strength gage, suspended sediment concentration gages, and various instruments for determination of the sulfur content of fossil fuels. X-ray fluorescence analysis may be used to determine lead in the atmosphere, paint, and blood. Neutron activation analysis and radiometric techniques may be used to determine trace elements in the atmosphere, the hydrosphere, and in plants and animals. Automobile exhaust and sulfur dioxide in stack gases can be determined by radio-release and chemical substitution. Mossbauer spectrometry is discussed, as well as the radiation treatment of municipal and industrial wastes.

34422

AUTOMATIC SYSTEM MONITORS PULP MILL GASEOUS EMISSIONS. Can. Pulp Paper Ind. (Vancouver), 24(10):57, Oct. 1971.

An automatic monitoring system was designed to meet the demands of proposed British Columbia legislation requiring the measurement of sulfur compounds in all gaseous emissions from pulp and paper mills. The system directly measures hydrogen sulfide, sulfur dioxide, and total sulfur from 0.1 ppm to several thousand ppm, and can also be used to measure methyl mercaptan, ethyl mercaptan, methyl sulfide, and dimethyl sulfide. The new system features a sulfur-phosphorus detector with a hydrogen-rich flame, a gas chromatograph, a permeation-tube calibration unit, and a gas-sample conditioning unit. The detector is specific to sulfur up to 1.0 microgram. Chromatograph columns are made from polyphenyl ether and phosphoric acid. A stripper column allows separation of H2S and SO2 from the other sulfur compounds present. The H2S and SO2 are then passed to an analytical column and to the detector for separation and measurement.

34863

Mulik, J. D., R. K. Stevens, and R. Baumgardner

AN ANALYTICAL SYSTEM DESIGNED TO MEASURE MULTIPLE MALODOROUS COMPOUNDS RELATED TO KRAFT MILL ACTIVITIES. Preprint, Southern California Univ., Los Angeles, 23p., 1971. 10 refs. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 12th, Los Angeles, Calif., April 6-8, 1971.)

Automated chromatographs with flame photometric detectors were developed for qualitative and quantitative analysis of both low- and high-molecular-weight sulfur compounds in kraft mill effluents. One chromatograph with a Teflon column packed with Teflon and coated with polyphenyl ether was used to measure the following low-molecular-weight compounds: hydrogen sulfide, sulfur dioxide, methyl mercaptan, ethyl mercaptan, and propyl mercaptan. A second chromatograph resolved the higher-molecular-weight compounds: butyl mercaptan, dimethyl disulfide, dipropyl sulfide, and dibutyl sulfide. Kraft mill effluents with sulfur species at five ppb to percent levels were analyzed with the aid of a six-stage dynamic dilution system. Principal emissions from mills employing the weak black liquor oxidation process were hydrogen sulfide and methyl mercaptan. Sulfur dioxide and hydrogen sulfide were the major pollutants from the strong black liquor oxidation process. (Author abstract modified)

35243

Cooper, Hal B. H., Jr. and August T. Rossano, Jr.

CONTINUOUS SOURCE MONITORING OF GASEOUS SULFUR COMPOUNDS IN THE PAPER INDUSTRY. Preprint, California Air Resources Board, Sacramento, and California State Dept. of Public Health, 42p., 1971. 31 refs. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 12th, Los Angeles, Calif., April 6-8, 1971.)

Monitoring techniques and regulatory aspects, including emission standards for gaseous sulfur compounds emitted by sulfite and kraft pulp mills are examined. Pulping processes, major sources, and principal pollutants, e.g., sulfur dioxide and sulfur trioxide, methyl mercaptan, dimethyl sulfide, and hydrogen sulfide, are reviewed. Continuous monitoring methods include electrolytic conductivity, ultraviolet spectrometry, coulometric titration, ultraviolet spectrophotometry, and process gas chromatography. Mobile laboratories, sampling procedures, flow measurement, and instrument calibration are discussed. Costs and manpower requirements for the instruments are included.

35956

Cooper, Hal B. H., Jr. and August T. Rossano, Jr.

SOURCE TESTING FOR AIR POLLUTION CONTROL. Wilton, Conn., Environmental Research and Applications, Inc., 1971, 228p. 532 refs.

Source testing for air pollution control is reviewed with respect to basic procedures, terminology, operating and theoretical priciples, gas flow measurements, sampling trains, principles and methodology of particulate sampling, gaseous sampling, continuous monitoring, and special applications of various techniques. Measurements of stack gas parameters prior to sampling are discussed for determinations of temperature, pressure, moisture content, and gas composition using such instruments as thermometers, thermocouples, thermistors, wet or dry bulbs, condensation methods, Orsat analyzers, pitot tubes, anemometers, tracers, balloons, and various meters. Instrumentation for particulate sampling includes sampling probes, flowmeters, wet impingers, filters, centrifugal separators, and electrostatic and thermal precipitators. Particulate sampling trains are examined with respect to specific contaminants (polynuclear hydrocarbons, fluoride compounds, mists, tars, and droplets); combustion sources, e.g., boilers, incinerators, open burning, pulp and paper plants, lime kilns, kraft recovery furnaces, chemical processing, and metallurgical operations; and particle size analysis using impingers and cascade impactors. Sampling techniques for gases containing sulfur oxides, hydrogen sulfide, mercaptans, total sulfur, nitrogen oxides, ammonia, chlorine compounds, carbon monoxide, and organic gases and vapors include absorption into a liquid phase, using sample probes and impingers; collection in fabric bags; adsorption on a solid; and freeze-out techniques. Subsequent analytical methods include wet chemical analysis (turbidimetry, colorimetry, potentiometry, polarography, iodimetric methods, and Orsat analysis) and instrumental analysis (gas chromatography, spectrophotometry, flame ionization, and mass spectrometry). Special applications for the techniques include determination of odor thresholds of flue gases, measurement of acid deposition onto metal surfaces, the presence of radioactive materials, and bacterial emissions to the atmosphere. Pertinent source test data and sources of equipment are included.

36894

Hoshika, Y., T. Ishiguro, Y. Shigeta, and N. Futaki

OBSERVATION ON THE BASIC INVESTIGATION METHOD FOR BAD ODOR FROM THE STANDPOINT OF ON-SITE TESTS. (A SEQUEL). (Genjoteki keiken kara mita akushu kogai kihon chosaho ni kansuru ichi kosatsu (zokuho). Text in Japanese. Preprint, Japan Chemical Society, Tokyo, p. 229, 1971. 2 refs. (Presented at the Japan Chemical Society, Fall Meeting, 25th, Osaka, Japan, Oct. 11-14, 1971.)

Odor sensitivity tests by the injection method, the six-stage intensity indication method, instantaneous olfactory index of pleasant and unpleasant sensations, and their correlations with equipment analyses were examined. Gas chromatography was used for equipment analyses. The staff members of the Japan Environmental Hygiene Center and their collaborators inspected control areas by an automobile. The odor of a Kraft Pulp Mill was detected within 10 to 14 km leeway. Measurements were taken by gas chromatography and by the olfactory sensitivy test 500 m from the mill with approximately 700 t/day, on a cloudy day with occasional rain, temperature 29 C, wind 3-5 m/sec. Considerable agreement was noted between the six-stage intensity indication method and the instantaneous olfactory index. Odor index was from 18 to 32.

37308

Cook, W. G. and R. A. Ross

GAS-CHROMATOGRAPHIC SEPARATION OF HYDROGEN SULFIDE, AIR, AND WATER. Anal. Chem., 44(3):641-642, March 1972. 8 refs.

A Porapak Q column linked to a Carbowax column was used for the gas-chromatographic separation of hydrogen sulfide from water- saturated air and water samples containing dissolved H2S. The gas samples analyzed were either synthetic or extracted directly from the main stack in the chemical recovery plant of a Kraft pulp mill. For both separations the injection inlet temperature was 120 C, the column compartment was 125 C, and the detector compartment was 175 C. The hot-wire current was kept at 150 mA with a recorder span of 1 mV for all samples. The minimum detectable concentration of H2S was about 50 ppm v/v. This procedure offers a rapid analysis time and definite separation of components without the need for temperature programming or cold traps.

37511

Devonald, B. H., R. S. Serenius, and A. D. McIntyre

EVALUATION OF THE FLAME PHOTOMETRIC DETECTOR FOR ANALYSIS OF SULPHUR COMPOUNDS. Pulp Paper Mag. Can. (Quebec), 73(3):50-53, March 1972. 3 refs. (Presented at the Canadian Pulp and Paper Association, Air and Stream Improvement Conference, 6th, Quebec, April 13-15, 1971, Paper T 68.)

The Melpar flame photometric detector for gas cromatographic analysis of sulfur compounds in pulp mill gas process streams was evaluated. The odor associated with kraft pulp mills is caused primarily by hydrogen sulfide emitted from the chemical recovery furnace and by various alkyl sulfides created during delignification of wood by cooking with a sodium hydroxide-sodium sulfide solution. Non-sulfur organics, e.g., ketones, alcohols, and terpenes, frequently present in pulp mill gas process streams, do not interfere with the analysis as they do with a flame ionization detector. However, a major drawback is the limited dynamic range of the flame photometric detector, which necessitates sample dilution for gases containing high concentrations of sulfur compounds. In addition, the high back pressure of the column used in the initial work (38 psi) resulted in frequent leaks in the apparatus. The use of the flame photometric detector, in conjunction with a Microtek GC 2000R Chromatograph, for analysis of sulfur compounds in several process streams of pulp mills is described. (Author abstract modified)

37718

Larssen, Steinar, David S. Ensor, and Michael J. Pilat

RELATIONSHIP OF PLUME OPACITY TO THE PROPERTIES OF PARTICULATES EMITTED FROM KRAFT RECOVERY FURNACES. Tappi, 55(1):88-92, Jan. 1972. 11 refs. (Presented at the Pulp and Paper Industry Technical Association Water and Air Conference., Boston, Mass., April 4-7, 1971.)

The theoretical and measured relationships between the plume opacity (one minus the fraction of light transmitted through the plume) and the properties of the particulates emitted from a kraft recovery furnace are compared. The plume opacity (Ringelmann number) was measured downstream from an electrostatic precipitator with a Bailey smokemeter. The particle size distribution and the particulate mass concentration were simultaneously measured with a cascade impactor and an alundum thimble, respectively. A linear regression analysis of the measured data showed that over the Ringelmann number range of 0.85-3.0 there is a nearly linear relationship between the logarithm of the plume light transmittance and the aerosol mass concentration. This relationship enables the determination of the particle mass concentration from measured light transmittance within (90% confidence) a concentration of approximately plus or minus 0.05 grains/std dry cu ft of gas at 0.3 grains/std dry cu ft of gas and plus or minus 0.1 grains/std dy cu ft of gas at 2.0 grains/std dy ft of gas. The effects of particle size distribution, particle density, and stack-gas temperature on the correlation between plume opacity and particulate mass concentration are discussed.

38032

Pecsar, R. E. and C. H. Hartman

AUTOMATED GAS CHROMATOGRAPHIC ANALYSES OF SULFUR POLLUTANTS. Anal. Instrum., vol. 9:H-2-1 to H-2-14, 1971. 7 refs.

Analysis for sulfur-containing pollutants is becoming mandatory in operations such as kraft paper mills, fossil fuel burning power stations, and petrochemical refineries. Gas chromatography is a versatile tool for accomplishing this analysis in the normal ppb-ppm concentration range. Typically an all-Teflon flow system is employed with detection by flame photometry. For best performance the flow rates to the detector should be preset to the optimum value of 88 cc/min air carrier, 80 ccm/min of hydrogen, and 20 cc/min of makeup air for flame stability. By utilizing air as the carrier, the disruptive effect of the air peak is eliminated and 12 ft of column suffices for an adequate separation of hydrogen sulfide, sulfur dioxide, and methyl mercaptan. In addition to the column and detector, care must be paid to the analyzer flow system and the electrical processing of the detector signal. An analyzer provides continuous, unattended analysis. Sulfur dioxide values measured with such a system in the San Francisco area appeared more reliable measurements than with a conductometric analyzer.

38698

Pilat, Michael J., David S. Ensor, and John C. Bosch

CASCADE IMPACTOR FOR SIZING PARTICULATES IN EMISSION SOURCES. Am. Ind. Hyg. Assoc. J., 32(8):508-511, Aug. 1971. 18 refs.

The design, application, and operation of a cascade impactor for measuring the size distribution of particulates in stacks and ducts are reviewed. The apparatus was used for source sampling in a coal-fired power plant, a kraft pulp mill recovery furnace, a fluidized bed sewage sludge incinerator, and a plywood veneer drier. The characteristics of the impactor include isokinetic sampling capabilities, prevention of water losses and water vapor condensation, structural ruggedness, and the ability to determine the aerosol size distribution with a minimum of effort and expense. (Author abstract modified)

39929

Hendrickson, E. R.

AIR POLLUTION SAMPLING AND ANALYSIS WITH SPECIAL REFERENCE TO SULPHATE PULPING OPERATIONS. Tappi, 42(5):173A-176A, May 1959. (Presented at Gulf Coast Section, Technical Association of the Pulp and Paper Industry, Mobile, Ala., March 13, 1959.)

A sulfate mill developed a stack sampling program to determine emissions of particulates, sulfur dioxide, hydrogen sulfide, and total from the recovery furnace. The sampling train consisted of a probe containing a Whatman paper thimble, fritted-glass scrubbers, flow-measuring devices, and a compressed-air ejector as a source of vacuum. Sampling was conducted at the rate of 0.1-0.3 cfm for as long as 1 hr. Sulfur dioxide was analyzed by the West and Gaeke method, H2S by the Fogo and Popwosky method, and particulates by drying the loaded filter in a desiccator to constant weight and weighing. Preliminary results indicate that these techniques and procedures have considerable merit and are worthy of further investigation. In areal sampling, the cost of obtaining continuously several hundred simultaneous collections may be prohibitive. One satisfactory approach is to obtain cumulative indications over a period of time by simplified techniques. The unit cost of such techniques is insignificant compared with more elaborate procedures and equipment. These techniques include fallout pans and jars, adhesive paper, and greased slides for aerosols; the lead peroxide candle method for SO2; and lead acetate-impregnated papers or tiles for H2S.

42403

Katou, Tatsuo

GAS CHROMATOGRAPHIC ANALYSIS OF ODOR POLLUTION IN ATMOSPHERE. (Gasu kuromatogurafu-ho ni yoru akushu no kankyo bunseki). Text in Japanese. Anzen Kogaku (J. Japan Soc. Safety Eng.), 10(2):97- 104, April 1972. 5 refs.

An analytical method for measuring odorous pollutants in the atmosphere, using the concentration process and gas chromatographic analysis, was developed. A high concentration apparatus for the GC sample was designed, based on the surface adsorption effect of fire brick cooled with liquid oxygen. An air sample of 100 l can be concentrated to a few milliliters with 100% efficiency in less than 10 min. Components with boiling points within - 100 to + 200 C were analyzed quantitatively; the analytical limit for detection with the flame ionization detector was 10 to the - 12th (ppt). The practical application of the method for field studies of odors emitted by kraft pulp mills, petrochemical combines, and fish meal plants is considered.

43214

Greenfelt, Peringe

INTROMISSION MEASUREMENTS OF GASEOUS SULPHUR COMPOUNDS IN THE VICINITY OF SULPHATE MILLS. Int. Air Pollut. Control Noise Abatement Exhib. Conf. (Proc.), Jonkoping, Sweden, 1971, p. 2:23 to 2:29. 6 refs. (Sept. 1-6.)

A flame photometric gas chromatographic method for simultaneous determination of voltile sulfur compounds down to concentrations of less than 10 ppb developed in the U. S. was copied by the Swedish Water and Air Pollution Research Laboratory and used for intromission measurements of hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide in the vicinity of three Swedish sulfate mills. In the flame photometer detector, the gases from the column are burned in a hydrogen- oxygen flame with a large hydrogen excess. This reducing combustion induces formation in the flame of sulfur gas which, through chemiluminescent reaction, emits light in the 300 to 423 nm waveband. By placing a filter between flame and phototube, which will only transmit light of wavelength approximately 394 nm, a selectivity of from 10 to 30,000:1 is obtained for sulfur compounds opposed to others. The signal from the phototube is proportional to the S concentration not directly but exponentially to the latter s power of 1.9. The calibration unit is described. The sampling probe was set up on the roof of a van about 2.5 m above ground level. The generator unit was always sited 5 to 10 m downwind from the van. No measurements were made further than 5 km from the source factory. The content of the various sulfur compounds varied widely in relation to each other from one analysis to the next. Preliminary findings point to good correlation between smell and instrument response.

43228

Wiklander, Gosta

MEASUREMENT OF THE EMISSION OF HYDROGEN SULPHIDE AND SULPHUR DIOXIDE FROM THE SODA BOILERS IN SULPHATE MILLS. Int. Air Pollut Control Noise Abatement Exhib. Conf. (Proc.), Joenkoping, Sweden, 1971, p. 2:13 to 2:22. (Sept. 1-6.)

Experiments in laboratories and in the field yielded certain information concerning the selection and processing of gas samples prior to analysis. The gas sample should be taken after going through the electrostatic precipitator, preferably after the flue gas fan. There should be no filter on the outlet pipe inside the waste gas duct because the filters may become clogged and gas reactions may take place within the filters. The actual gas sample pipe must be kept as short as possible, and it must be heated and insulated so that the temperature of the pipe always is above the dew point. It is important to obtain rapid cooling of the gas with minimum contact time between gas and condensate. The cooler must be provided with a proper drop-separator with suitable trap for the condensate, for example a mercury lock. From the cooler, the gas is led to a filter and then to a gas pump which forces the gas sample to the analyzing apparatus. A tape apparatus is the recommended method of analysis for hydrogen sulfide. An automatic titration apparatus may also be employed. During the greater part of a period of 10 days, a soda recovery unit showed a low H2S emission, 0-3 ppm. Duration of emission peaks may be from 10 to 15 min, and in adverse cases up to several hours. During the 10 days, the emission value of 10 mg/cu m was exceeded for a total of 520 min, or about 3.6% of the operation time. Operation with low emission is dependent upon good supervision of unit operation. A new recovery unit was tested for emissions at a variety of air flows. At 160,000 cu m/hr the H2S emission was around 1 mg/cu m. When sulfate addition to the unit was stopped, there was a relatively rapid reaction in the form of increasing H2S content. The sulfur dioxide in the waste gases of recovery units is between 500 and 1000 mg/cu m.

43479

Gilbreath, R. H., Jr.

SAMPLE SYSTEMS FOR ON-LINE SOURCE MEASUREMENTS OF PULP MILL WASTE GASES. Technical Assoc. of the Pulp and Paper Industry, New York, Tappi Eng. Conf., 26th, Proc. 1971, p. 581-594. 9 refs.

Controlled conditioning of representative waste gas samples for on-line composition analysis of pulp mill waste gases is the prime function of a properly designed sampling system. The sample system design is influenced by selection of final analysis instrumentation, source stream compositions, and physical locations of the sampling probe. The system must maintain constant temperature, pressure, and flow of the gas sample stream. Undesirable stream components must be removed if their presence diminishes and analysis instrumentation sensitivity. Probe design and placement and the components and functions of the gas sampling system are described. Typical kraft mill waste gas compositions are presented.

43684

Pecsar, R. E. and C. H. Hartman

AUTOMATED GAS CHROMATOGRAPHIC ANALYSIS OF SULFUR POLLUTANTS. Analysis Instrumentation, vol. 9:1-4, 1971. 8 refs.

The analysis of sulfur-containing pollutants is becoming mandatory in operations such as kraft paper mills, fossil-fuel burning power generation, and the petrochemical refining industry. Gas chromatography is a versatile tool for accomplishing this analysis in the normal ppb to ppm concentration range. Typically an all- Teflon flow system is employed with detection by flame photometry. However, many procedures have become commonplace which do not actually represent optimum system operation. Results are presented showing individual component as well as total system optimization in relation to detector flow rates, electrical operating parameters, and noise reduction. The best column fabrication means as well as flow rate effect are discussed with methods for achieving optimum column and detector operation. For the low-level analysis of sulfur pollutants the importance of design attention to the entire system is stressed. The practical application of all these considerations was demonstrated with monitoring data obtained on a number of industrial stationary sources in the San Francisco Bay Area. An analyzer embodying the desired characteristics can be mated with an automated sequence programmer to provide continuous analysis and intermittent calibration completely unattended. (Author abstract modified)

D. AIR QUALITY MEASUREMENTS

00209

R. Cederlof, M. L. Edfors, L. Friberg, and T. Lindvall

DETERMINATION OF ODOR THRESHOLDS FOR FLUE GASES FROM A SWEDISH SULFATE CELLULOSE PLANT. Tappi, 48(7):405-411, July 1965. Nord. Hyg. Tidskr. Vol. 46:51-56, 1965, Danish.

The purpose of the investigation was to determine the odor thresholds of complex flue gases from two Swedish sulfate certain individual processes on the odor strength of the total measures were also studied. Odor threshold determinations were made by means of an exposure apparatus especially devised for field studies. The subjects were tested according to the principle of paired comparisons between test gases (in different dilutions) and fresh air. The odor threshold was evaluated as a value, expressing the logarithm of the dilution factor at which on the average 50% of the subjects noticed the odor. The odor strength of the flue gases from the two stacks investigated were markedly similar. Parallel chemical analysis showed a correlation between the concentration of the sulfur compounds analyzed and the odor threshold of the gases. In studying the odor reducing effect of various technical measures it was found that oxidation of the flue gases with black liquor reduced the odor threshold by approximately one power of 10 and the use oa a 'chlorine scrubber' by two powers of 10. (Authors' abstract)

00690

H. P. Sanderson, P. Bradt, and M. Katz

A STUDY OF AIR POLLUTION IN SAINT JOHN, NEW BRUNSWICK, CANADA. Preprint. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-135.)

An analysis has been made of air pollution data gathered over a two-year period in the City of Saint John, N.B., which has a population of about 95,000. Apart from normal activities, this town is also the site of a large Kraft pulp and paper mill and an oil refinery. Continuous measurements of smoke concentrations with AISI paper tape samplers and more limited observations of hydrogen sulphide with lead acetate impregnated paper tape samplers were carried out at two sampling sites in each case. The study has been conducted in cooperation with the Saint John Board of Health and the Meteorological Branch, Canada Department of Transport. The soiling index values in Coh units per 1000 linear ft. show a strong seasonal trend. The soiling potential is markedly higher during the heating season than in the late spring, summer and early fall months. There is also evident a diurnal variation in pollution with a relatively high frequency of heavy concentrations occurring during the morning hours between 8 and 9:30 a.m., with a secondary peak in the evening. The observations have been correlated with wind speed and direction. A comparison has been made of these results with similar data from eight other Canadian cities. Hydrogen sulphide, as an index of the odor nuisance due to sulphur compounds, has been detected on many occasions, coincident probably with subjective reports of such occurrences or reported blackening of painted buildings. (Author abstract)

03017

P. A. Kenline

IN QUEST OF CLEAN AIR FOR BERLIN, NEW HAMPSHIRE. Public Health Service, Cincinnati, Ohio, Division of Air Pollution (Technical Rept. No. A62-9) 53 pp., 1962

The city of Berlin, with a population of 15,000 is a manufacturing area. Manufacturing accounts for over half of all employment, with 1 plant accounting for 80% of this toal. The population has been gradually decreasing since 1930. The city proper occupies 4 square miles and is situated in a valley such that frequent inversions, confinement of lateral dispersion, and weak winds allow periods of pollutant accumulation. Levels of suspended particulate matter (averaging 183 ug./cu m) and dustfall (35 tons/sq. miles/30 days) are relatively high, compared to levels measured in other areas. Levels of sulfur dioxide (averaging 16 ppb.), hydrogen sulfide (max. 23 ppb.), and malodors, although not generally or consistently high, do not reach levels where undesirable effects are produced. Pollution was heaviest in areas near the pulp mill and tended to carry down the valley. Air pollution problems exist in Berlin and have reached levels that justify constructive efforts to ameliorate the situation. It was concluded from the study that emissions from other than industrial operations are not of sufficient magnitude to warrant consideration of control measures. Since all of the 9 initial steps to achieve control op pollutionnrelated to Brown Co., it was suggested that the Berlin City Council request the Company to undertake the 1st 7 items and report their findings to the Council. The last 2 items require only diligence on the part of the Company with regard to operation and good housekeeping.

03106

D.F. Adams R.K. Koppe

AN AIR QUALITY STUDY IN THE VICINITY OF LEWISTON, IDAHO, AND CLARKSTON, WASHINGTON. J. Air Pollution Control Assoc. 16, (6) 314-6, June 1966. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965.)

This report summarizes data and conclusions from a one-year, interstate air quality study conducted in 1962 in the vicinity of Lewiston, Idaho, and Clarkston, Wash. The sampling and analyses techniques were selected to permit differentiation between possible sources and types of air pollutants. Average suspended particulate values in downtown Lewiston and Clarkston were approximately 1.6 times above the average suspended particulate loadings in a complex of commercial-industrial suburban activity of North Lewiston. At the same time the hydrogen sulfide values were usually higher in North Lewiston than at the downtown sites. Average soiling indexes were relatively low. Dustfall ranged from 7.4 to 315.4 tons/sq mile per month above background. Distribution of the dustfall components indicated a multiplicity of dust sources, including high background levels attributed to airborne soil particles from adjacent farm land. The heavy dustfall in the downtown commercial areas of Lewiston and Clarkston contained a high percentage of self-generated material not related to a specific industrial source. Conversely, greater quantities of sodium and sulfate were found in the North Lewiston dustfall than elsewhere and were probably related to pulp production. Substantially higher levels of suspended particulates and dustfall (loss on ignition fraction) were found during the heating season. The lead peroxide candle 'sulfation' rate showed that a significant part of the sulfur content of the air came from multiple community sources including comfort heating, cehicular travel, and waste disposel. Two weather conditions were associated with increased ground-level concentrations of pollutants-low level nocturnal inversions and synoptic, stagnating air masses. Increased air stagnation also contributrd to the higher gaseous and particulate levels during the heating season. (Author summary modified)

06535

T. O. Carver,B. Bucove,V. G. Mackenzie,and A. N. Heller

AN APPROACH TO A SOLUTION OF AN INTERSTATE AIR POLLUTION PROBLEM. Preprint. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 1964.)

A six-months study (1961-1962) of an air pollution problem in Lewiston, Idaho and Clarkston, Washington was made jointly by the Departments of Health of Idaho and Washington and the Division of Air Pollution, Public Health Service. Aerometric studies, meteorological conditions, materials damage, and emission inventories were evaluated and preliminary considerations of health effects were made. Socio-economic aspects via a public awareness study of air pollution in Clarkston, Washington are reviewed in terms of survey methodology and analysis. Complementary studies of an odor survey in both Lewiston and Clarkston are interpreted. The development of a number of joint recommendations to solve the immediate air resource management problem and allow for future economic growth in the valley is explored. (Authors' abstract)

07390

A. J. Lynch, E. J. Bowmer, A. Sykanda, J. H. Smith, J. H. Emslie

COMPARISON OF METEOROLOGY AND AIR QUALITY BETWEEN TWO COMMUNITIES IN BRITISH COLUMBIA--A PRELIMINARY REPORT. Can. J. Public Health (Toronto), 58(6):241-248, June 1967. 16 refs. (Presented at the Annu. Meeting, Air Pollut. Contr. Ass., Pacific Northwest Int. Sect., Seattle, Wash., Nov. 3-4, 1966.)

Two series of sampling stations have been established to develop methods for the comparison of meteorological and air quality findings in an area exposed to the contaminants from kraft pulp and paper mills with an unpolluted control area. The climate was maritime in both towns and there were inversions in both valleys in both winter and summer. The preliminary report covers the methods used in establishing the sampling stations and the meteorological observations and analyses made between Oct. 1965 and June 1966. Six stations were established in the polluted town and three in the control town in industrial, commercial, and residential locations. The study will continue until March, 1968 with additional meteorological and air quality measurements. Preliminary values show the dust fall in the polluted town varying from 20 to 50 tons per sq mile and from 4 to 10 tons per sq mile in the control town. A secondary object of this study was to relate the concentration of air contaminants to the incidence of respiratory disease and to assess the long- term effects on health of low concentratjons of contaminants.

07572

Benforado, D. M. and G. Cooper

THE APPLICATION OF DIRECT-FLAME INCINERATION AS AN ODOR CONTROL PROCESS IN KRAFT PULP MILLS. Preprint, (19)p., (1968). 18 refs. (Presented at the 22nd Engineering Conference, Process Systems & Controls Water & Air Pollution, TAPPI, Atlanta, Ga., Sept. 19-22, 1967.)

A method of controlling the odors in Kraft Pulp Mills by direct-flame incineration is discussed. The design criteria, as well as the incorporation of heat recovery equipment, is covered. A method of quantitatively measuring the odor strength of waste gases and the use of this method to determine effectiveness of control equipment is also discussed. The intent of the paper is to offer one method of air pollution control which appears to be applicable to Kraft Pulp Mills and which may be equated with other methods presently being considered. (Authors' abstract)

09592

Public Health Service, Washington, D. C., National Center for Air Pollution Control

LEWISTON, IDAHO, CLARKSTON, WASHINGTON AIR POLLUTION ABATEMENT ACTIVITY. 61p., Feb. 1967. 18 refs.

Investigations of air pollution in the community have been concerned with air quality, meteorology, sources of pollutants, and various effects of air pollution. There are numerous sources of air pollution in the community; the largest of these is a kraft pulp mill located just east of Lewiston. Other sources include: Lumbering Operations; Asphalt Mix Plants; Food Processing Plants; Concrete Mixing and Grain Handling; Fuel Usage; Refuse Disposal; and Vehicular Emissions. The interstate movement of pollutants, particularly odorous gases emitted by the pulp mill in Idaho and transported to Clarkston, Wash., has been demonstrated. In a public opinion survey in Clarkston, Wash., more than 90 percent of the persons interviewed perceived air pollution in the community as a malador problem. The pulp mill reported emissions amounting to about 1,800 pounds of hydrogen sulfide, 2,500 pounds of mercaptans, and 1,000 pounds of organic sulfide gases per day; about 23,000 pounds of particulates, consisting mostly of sodium sulfate and sodium carbonate per day, from the mill's recovery furnaces; and an average of about 9,700 tons of water vapor per day from all operations. Calculated daily emissions of selected pollutants from sources other than the pulp mill included about 4,000 pounds of particulates, 100,000 pounds of carbon monoxide, and more than 20,000 pounds of hydrocarbons. About two-thirds of the community emissions are released in Idaho and about one-third in Washington. The valley topography of the Lewiston-Clarkston area results in the transport of air pollutants alternately from either of the states to the other.

09658

Harding, C. I.

SULFATION AND CORROSION MEASUREMENTS IN A MARINE COASTAL CITY OF FLORIDA. In: Proceedings of the International Converence on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed), Sponsored by: Public Health Service, National Council for Stream Improve- ment, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 354-357

As part of a comprehensive survey in a Marine coastal city in Florida, measurements were made of corrosion rates and sulfation rates. The location of pulp mills, power plants and static samp- ling stations are shown on a map. Sampling stations were located throughout the entire area of 15 miles by 15 miles. At each sta- tion, sulfation, dustfall, fluoride by limed paper, and corrosion were monitored. All stations were changed once a month. A 1000- foot television tower was located at the center of the grid. Sul- fation was measured by the lead dioxide-candle method. The units which were used for expressing sulfation rate were micrograms of SO3 per square centimeter per day. Corrosion measurements were made using carbon-steel plates which were cleaned, dried and weigh- ed, and exposed for the 30-day period. Following exposure each plate again was cleaned and reweighed. The unit of measurement for corrosion rate was milligrams of metal oxidized per square centimeter per month. In order to determine the effect of marine environment on corrosion rate, a separate series of sampling sta- tions was located on a line through the television tower beginning at the beach front and running into town. At the waterfront 15 miles from the center of town, the corrosion rate was very high but moving back from the beach, rates dropped off rapidly to a back- ground level. The highest corrosion rates were noticed north of the T. V. tower area, in the center of the industrial area. The corrosion rate with vertical distance was also measured at the T. V. tower. These data indicate that the plumes from both the power plants and pulp mills have a corrosive influence. The background corrosion rate in this community is rather high as would be expected in a coastal city.

12345

Alkire, H. L.

AIR POLLUTION IN GARRETT COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control, 28p., March 1969. 12 refs.

The results of a preliminary survey of air pollution conditions, collected from existing data and personal interviews in Garrett County, Md., are presented. The county, the westernmost in the state, is the second largest in area but the most sparsely settled. Its topography, meteorology, and land use are described. Visual and odor observations and pollution measurements show that a serious air pollution problem exists in the Bloomington area in the valleys of the southeastern portion of the county. This problem originates outside the boundaries of the county, specifically in the Luke, Maryland - Beryl - Hampshire, West Virginia area. Bloomington School had suspended particulate at 135%, dustfall at 300%, and sulfation at 120% of satisfactory levels. The main sources of contamination in the Bloomington area are the paper mill at Luke, the charcoal plant in Beryl, and a coal screening operation in Hampshire. No measurements of air pollution have been made in the other portions of the county, but indirect indicators suggest that no serious air pollution problems exist, or are likely in the foreseeable future. Several recommendations are made for improving the pollution problems now existing.

12496

National Air Pollution Control Administration, Washington, D. C., Bureau of Criteria and Standards

REFERENCE BOOK SUMMARY OF NATIONWIDE EMISSIONS. Preprint, 36p., 1969 (?).

Estimates for the year 1966-1967 of nationwide emissions of the five primary air pollutants, carbon monoxide, oxides of nitrogen, sulfur oxides, particulates, and hydrocarbons, are presented. Information is broken down by source category, urban and non-urban location, selected air quality control regions, and projected motor vehicle emissions. The accuracy of the estimates is varied due to incomplete information and inadequately defined emissions. Sources include motor vehicles, gasoline and diesel engines, aircraft, railroads, vessels, coal, fuel oil, natural gas, wood, solid waste disposal, primary and secondary metal industry, cement manufacture, oil refineries, chemical processing, paper manufacture, and feed milling. A summary of the methodology used to arrive at the estimated figures is presented.

12648

S. F. Galeano

HOW TO DEVELOP AIR SURVEILLANCE PROGRAMS FOR PULP MILLS. Paper Trade J., 153(1):41-43, Jan. 6, 1969. 2 Refs.

Air quality and emission standards are being prepared and implemented by local and state authorities on a continuing basis. Emissions to the atmosphere by pulp and paper mills, as well as other industrial plants, will be governed by these standards. The most meaningful contribution of a paper mill air surveillance program would be in providing data essential to the establishment of realistic air quality standards. With such a program supported by management, a company will be in a position to authoritatively recommend realistic air criteria for the area surrounding a particular manufacturing facility. A substantive surveillance program is outlined.

16062

Donkelaar Van, A.

AIR QUALITY CONTROL IN A BLEACHED KRAFT MILL. Can. Pulp Paper Assn., Tech. Sec., p. T346-T350, 1967 (?). 10 refs. (Presented at Paper Ind. Air and Stream Improvement Conf., 3rd, Vancouver, B. C., 1967.)

The air pollution control program of a bleached kraft mill in northern Calif. is described. By using black liquor oxidation, hydrogen sulfide emissions from the stack were reduced to near zero, and a high degree of efficiency in eliminating mercaptans and organic sulfides was reached through treatment by incineration. A detailed in-plant monitoring program for measuring emissions is described and the results reported weekly to the local Air Pollution Control District. The use of telephone responses and home monitoring systems are also valuable. Four-hour checks on critical equipment, weather measurements, and an ambient air monitoring program in which particulate fall-out is measured at seven stations, are also part of the control program. Data show typical main stack emissions, lime kiln stack emissions, and green liquor dissolver stack emissions.

16619

Adams, D. F. and R. K. Koppe

AN AIR QUALITY STUDY IN THE VICINITY OF LEWISTON, IDAHO, AND CLARKSTON, WASHINGTON. Washington State Univ., Pullman, Div. of Industrial Research, Rept. 65-138, 32p., 1962. 12 refs.

A one-year air quality survey in the vicinity of Lewiston, Idaho and Clarkston, Washington was conducted. Air samples were collected or measurement of dustfall, suspended particulates, soiling index, sulfation, hydrogen sulfide, and reducing gases. The survey area is characterized by a prevailing light easterly wind drift with occasional strong gusts accompanying the passage of self-developed frontal systems from the west. High valley walls, by limiting northerly or southerly dispersion, contain much of the pollutants within the valley. The study year was characterized by greater than normal turbulence, favoring dilution and wider dispersion of pollutants. Suspended particulate loadings ranged from average to excessive for urban areas, and values for downtown Lewiston and Clarkston were 1.6 times the average in a complex of commercial-industrial-suburban activity. The average values for soiling index were considered light. Analysis of the components of dustfall indicated a multiplicity of dust sources, including high background levels attributed to airborne soil particles swept in from adjacent areas. The heavy dustfall of downtown commercial areas contained a high percentage of self-generated material not related to a specific industrial source. Dustfall in suburban areas contained greater quantities of sodium, calcium, and sulfate than were found elsewhere and were probably related to kraft pulping. Data indicated a need for reduction of emissions of particulate matter of all kinds. Odorous sulfur gases were found throughout the areas with the highest levels in North Lewiston. Low-level inversions and synoptic, stagnating air masses were associated with ground-level fumigation of these gases. When such periods develop, the natural fog and the man-made pollutants become indistinguishable. Sulfation shows that a significant part of the sulfur content of the air arises from multiple community sources including comfort heating, vehicular travel, and waste disposal. Substantially higher levels of particulate and gaseous pollutants were obtained during the heating season, indicating that emissions resulting from combustion of fuels contributed significantly to overall air pollution. Winter meteorological stagnation, less favorable for dispersal of pollutants, also contributed significantly to the higher pollutant levels found during the heating season. (Author abstract modified)

17630

Kogo, Tetsutaro, Ryosaku Endo, Tatsunori Oyake, and Hiroshi Shirakawa

OFFENSIVE ODORS. 9. INVESTIGATION OF THE EXISTING CONDITIONS IN HOKKAIDO WITH RESPECT TO OFFENSIVE ODORS (FIRST REPORT). INVESTIGATION OF THE ORIGINS OF THE ODORS, THE DAMAGE BEING CAUSED, AND THE REACTIONS AND ATTITUDES OF THE LOCAL RESIDENTS. Taiki Os Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-58, 1967. Translated from Japanese. 4p.

Out of 1586 cases of complaints and petitions concerning public hazards received by the Hokkaido local government in 1965, those related to offensive odors accounted for 25.6%. An investigation of the situation was conducted. The sources of odor included marine products processing plants, animal stockyards, paper manufacturing factories, garbage and trash disposal facilities, agricultural products processing plants, and animal carcass disposal facilities. An investigation of odor diffusion was conducted at 23 different offensive odor sites. Twenty-four measuring points were set up on concentric circles of radius 500, 200, 100, and 50 m, with the plant being the center. The measurements were made with the sense of smell. At distances of more than 100 m, the number of appraisals of 'no odor' was greatest, then 'faint odor', 'definite odor', 'very strong odor', and 'unbearable odor', in that order. Occurrence rates of 'definite odor' were highest downwind of the source, and the odor extended to a greater distance. Questionnaires were distributed to residents of the area, and inquiries were made concerning their reactions and attitudes toward the odor. A total of 70.9% of all the people interviewed appraised the odor to be 'definite odor' or greater.

20377

Zhilin, P. N.

ATMOSPHERIC AIR POLLUTION IN LITHUANIAN CITIES. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8: 174-179, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

The results of a series of air quality measurements made over a period of years in the cities of Vilna, Kaunas, and Klaipeda are reported. Two electric heat and power stations and a number of manufacturing plants were found to be the chief sources of pollution in the Lithuanian SSR, as determined by dust measurements. Children living in the vicinity of one of the power plants were examined in 1952 for respiratory effects from pollution; the resulting morbidity data showed that influenza, adenoids, pulmonary tuberculosis, and pneumonia occurred most frequently among children living in the areas of greatest air pollution. It is recommended that dust collectors be installed at coal- and steam-operated electric stations and that two large power plants and most smaller domestic and industrial buildings convert to gas burning. In addition, the cellulose paper plant in Klaipeda should take steps to reduce sulfur dioxide emissions, some changeover to electric transportation systems should take place, and certain industrial plants should be moved to locations away from populated areas. Inspection and reporting stations are needed to achieve greater pollution control.

22591

Zhilin, P. N.

ATMOSPHERIC AIR POLLUTION IN LITHUANIAN CITIES. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:174-179, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

Results of an investigation of the air quality of several Lithuanian cities indicate that two electric heat and power stations, a cellulose-paper combine, and a sulfate plant are major contributors to air pollution. At 100 m and 300 m from one of the two power stations, dust concentrations were, respectively, 22 times and 35 times in excess of the allowable limits. The highest dust concentrations from the other station were found at a distance of 300 m; this may be due to the fact that the station's 99-m smokestack carries the ash farther before it begins to settle. Numerous complaints were received from residents living 300-499 m from the station. Influenza, pulmonary tuberculosis, and pneumonia occur frequently among children living in the area of the 99-m stack. The present investigation also disclosed an increase in serious respiratory disturbances in children residing near the cellulose-paper combine's new acid producing plant. Sulfur dioxide emissions from this plant exceed by 10 times the allowable concentration. It is recommended that the electric power plants be equipped with dust collectors and that sulfur dioxide emissions from the cellulose-paper combine be controlled by proper absorption equipment. It is further recommended that railroad transportation be electrified and that foundries and other industries emitting dust and gases be separated from populated areas by a sanitary clearance zone.

24227

Randerson, Darryl

THE DISTRIBUTION OF MN AND BR IN AN URBAN AREA AS REVEALED THROUGH ACTIVATION ANALYSIS. Atmos. Environ., 4(3):249-257, May 1970. 8 refs.

In an attempt to identify some of the components of air pollution in Houston, fifteen high-volume samplers were operated continuously for 24-hr periods. The major industries in Houston consist of oil refineries and petrochemical plants as well as secondary manufacturers such as steel mills, fertilizer companies, and paper mills. Filter papers from one day of sampling were irradiated in a thermal neutron flux and the resulting radio- nuclides were identified. Manganese and bromine were detected. The primary source of Mn compounds probably would be process losses from cement companies, chemical companies, and a steel mill located upwind from the sampling stations, while it is proposed that the Br compounds may have originated from ethyl fuel combustion. During one 24-hr period, the concentrations of Mn ranged from 0.02 to 0.56 micrograms inverse cu m while those of Br ranged from 0.04 to 1.09 micrograms inverse cu m. The spatial distributions of these two elements were related to the meteorological conditions. Patterns of concentration appeared to be related to the predominant direction of wind. Depending on the elements to be detected, the average cost per sample is estimated to be between $50 and $100. (Author abstract modified)

27673

Hiroshima Prefectural Government (Japan), Dept. of Hygiene

AIR POLLUTION IN HIROSHIMA PREFECTURE. 1ST REPORT. (Hiroshima- ken ni okeru taikiosen. Dai 1 po). Text in Japanese. 374p., Feb. 1970.

Air pollution caused by soot and dust has become a social problem in Hiroshima Prefecture, both in Otake city (where the main industries are paper manufacturing and petrochemicals) and in Kure city (with iron and steel and shipbuilding industries). Environmental investigations were carried out by the municipal authorities concerned, and fundamental investigations by the prefectural authorities, in order to designate the polluted areas as defined under the anti-pollution law. Based on the results of these investigations, Otake city was designated as suffering from air pollution from March 1968, and Kure city from March 1969. The extent of air pollution has subsequently been kept under continuous surveillance. This report describes the results of the fundamental survey of the designated areas carried out by the prefectural authorities, and the basic survey of air pollution carried out by the municipal authorities, divided into regional groupings of 8 districts in Hiroshima Prefecture (Otake, Kure, Fukuyama, Mihara, Hiroshima, Onomichi, Takehara, and Fuchu city). The results of controls established under the anti- pollution law and a survey of specific harmful substances are also given.

31276

Hokkaido Inst. of Public Health, Sapporo (Japan)

REPORT ON THE RESULTS OF AIR POLLUTION INVESTIGATION IN HOKKAIDO. PART VI. (Hokkaido no taikiosen chosa sokutei kekka hokoku. Dai-6-ho). Text in Japanese. 210p., March 1970.

Air pollution was measured in Muroran, Asahikawa, Kushiro, Tomakomai, and Obihiro, in Hokkaido from April 1968 to March 1969. In Muroran, the main influence on air pollution is the strong wind from the northwest and west northwest that brings the pollutants from the industrial to residential areas. For example, at one station, 52.66 tons/sq km/month of settling dust was recorded as the annual average. Sulfur dioxide concentration measured by electroconductivity was much higher than in other cities. Asahikawa had an annual average settling dust of 56.7 tons near the industrial plants, and during the cold season, sulfur dioxide was concentrated in the residential areas. In Kushiro, the annual average concentration was 0.34 mg sulfur trioxide/100 sq cm/day, and the maximum was 1.14 in January. Sulfur dioxide was relatively more concentrated in industrial and residential areas during the colder season. In Tomakomai, settling dusts were not very significant, and sulfur dioxide, measured by the lead peroxide candle method, was concentrated around the center city and near the paper manufacturing plant. In Obihiro, air pollution is not yet serious, but the tendency of a metropolitan-type air pollution (pollution from heating) is becoming apparent.

33108

Fuji City Citizens Committee for Environmental Pollution Control (Japan)

REPORT OF THE SURVEY ON PUBLIC NUISANCE IN FUJI AREA (1). (Fuji chiiki kogai chosasho, dai 1-pen). Text in Japanese. 88p., Sept. 1969.

Pollution in the Fuji industrial area includes detailed data on climatic characteristics, the mechanism and the state of air pollution in the area centered around Motoyoshihara Junior High School, comparison with Yokkaichi city, bad odor and noise, sources of odor emission, a survey of respiratory diseases in the area, results of questionnaires, water pollution of the sea and rivers, influence of pollution on plants and agricultural produce, and the state of pollution in the neighboring Fujikawa township. Fuji Municipal Motoyoshihara Junior High School is located in the most polluted area in the entire Fuji industrial complex; situated on a sand dune near the shore of Suruga Bay, it is flanked by four large plants on the west and 10 on the north. The sulfur dioxide counts go up characteristically with north-northwest winds; with 5 m/sec winds, it can go above 0.1 ppm. The average SO2 count from five months in 1968 was 0.093 ppm. The pollution sources include Kraft pulp mills, cellophane plants, chemical factories, Tagonoura port dredgers, aluminum electrolysis plants, fertilizer plants, and automobile exhaust gas. In the neighboring Kanbara township, there is also a light metal company. Pollutants are soot and other particulates (lime, mirabillite), sulfur dioxide, hydrogen sulfide and other sulfides, hydrogen fluoride, chlorine gas and chlorides, nitrogen compounds, and dusts. According to the investigation in April 1968, the total heavy oil consumption in Fuji city was 2,240 kl/day; black liquor, 2,750 kl/day; coal, 23 t/day; coke, 5 t/day; and wood, 16 t/day. The calculated total sulfur dioxide emissions was 130 t/day from heavy oil and 49 t/day from black liquor. According to an investigation by the Fuji Medical Association between Nov. 1967 and Oct. 1968, bronchitis and asthma cases in the polluted areas were 2.5 times as many as those in nonpolluted areas, and cases of asthmatic bronchitis in the former were four times as many as those in the latter. The ratio of asthmatic children in polluted and nonpolluted areas was 37:18; the number of absences, 131:27; and average absence per child, 3.63:1.49.

33708

Koike, Kazumi, Norikatsu Hanamura, Kazuma Ishida, Banichi Tomida, Jun-ichi Hayashi, and Kazuo Toyoshima

DUST FALL IN THE NEIGHBORHOOD OF A PAPER MANUFACTURING FACTORY (V). (Seishi kojo shuhen no kokajin chosa ni tsuite. (Dai 5 ho)). Text in Japanese. Aichi-ken Eisei Kenkyushoho (Rept. Aichi Inst. Public Health), no. 21:145-150, March 1971. 6 refs.

Dust fall measurements in the vicinity of a pulp paper factory were correlated with effects of wind direction and velocity, rainfall, and output of pulp. Samples were collected by deposit gauge on a monthly basis. The increase in dust fall value at two measuring stations determined the influence of wind direction in the summer. Later measurements showed no increase in dust fall concentration, determining that the absolute quantity of particulate matter discharged from the factory was decreased, and the deposit gauge was effective.

35051

Bosch, John C., Michael J. Pilat, and Bjorn F. Hrutfiord

SIZE DISTRIBUTION OF AEROSOLS FROM A KRAFT MILL RECOVERY FURNACE. Tappi, 54(11):1871-1875, Nov. 1971. 11 refs.

The size distribution of particulates emitted from a kraft mill recovery furnace was measured using a source test cascade impactor designed for isokinetic sampling directly inside the stack. The distributions were calculated from the weight of solids deposited on each impactor stage. Particle mass median diameter was one micron at the electrostatic precipitator inlet and 1.4 micron at the outlet. Sodium chloride concentration was higher in the submicron particles at the electrostatic precipitator outlet but independent of size at the inlet. (Author abstract modified)

35437

FINAL REPORT ON THE EMISSIONS INVENTORY FOR THE STATE OF ALABAMA. TRW Systems Group, McLean, Va., Washington Operations, Office of Air Programs Contract 68-02-0048, 93p. Aug. 1971. 33 refs. NTIS: PB 203467

Under the Clean Air Act of 1970, as amended, each state is required to submit a plan for the implementation and enforcement of national ambient air quality standards for each air quality control region in the state. An initial requirement for each of these plans is an emission inventory for each designated region. The Alabama Emission Inventory is summarized in charts and tables that serve as a guide to control strategy development and selection. Point source data required for preparation of the report were obtained from questionnaires and follow-up contacts with individual sources; area source data were obtained from various governmental agencies and personal contract with knowledgeable individuals. All data were transferred to prepared computer load sheets and processed by the Environmental Protection Agency inventory computer program. The Metropolitan Mobile and Birmingham areas were divided into grid networks for the purpose of apportioning the emissions in these areas. All other emission totals are reported by political jurisdiction and region. Sources included coal boilers and burners, fuel oil burners, natural gas boilers, open burning, incineration, solvent evaporation, diesel engines, railroads, ships, gasoline motor vehicles, surface coating, petroleum refining and distribution, wood burning, solid waste disposal, pulp mills, and power plants for residential, industrial and commercial areas. Sulfur dioxide, carbon monoxide, hydrocarbons, particulates, and nitrogen oxides were measured.

37968

Kifune, Ikuei, Toshiichi Okita, and Riuichi Sugai

RELATION BETWEEN ODOR INTENSITY FOR NUISANCE SOURCE AND ODOROUS GASES OF AROUND KRAFT PULP MILLS. (Parupu kojo shuhen no akushu gasu nodo to shukido oyobi hasseigen kyodo to no kankei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 6(1):225, 1971. (Presented at the National Council Meeting of Air Pollution Studies, 12th, Nagoya, Japan, Oct. 27-29, 1971.)

The odor concentration and malodorant concentration in and around the kraft pulp mill in Niigata Prefecture were measured. Samples were collected at the inlet and outlet of the malodorant treatment tower and oxidation tower and at locations 100, 200, 500, 800, 1000, and 1500 m from the source; samples were analyzed by gas chromatography and spectrophotometry. The highest concentration was found at the inlet, i.e., methyl mercaptan 103,484 ppm, dimethyl sulfide 22,754 ppm, and hydrogen sulfide 674.3 ppm which were reduced to 1/2 to 1/300 at the outlet. The ratio of sulfide compounds in the surrounding area was similar to the composition ratio at the source. The relationship between the odorant concentration and odor concentration was quantified according to the Weber-Fechner law.

41167

Suzuki, K., A. Nishidate, and S. Izumi

AN INVESTIGATION AND STUDIES ON THE STATE OF POLLUTION AND COUNTERMEASURES IN AOMORI. (Aomoriken ni okeru kogai no jittai t taisaku ni kansuru chosa kenkyu). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):2, 1969. (Presented at the Japan Society of Air Pollution, Annual Meeting, 10th, 1969.)

With the construction starting in about 1965 of numerous new industries in addition to the previous marine product industrial, Hachinoe City, Aomori Prefecture foresaw an increase of various types of pollution including odor, soot, stack gas, noise, and vibration. The new construction included 404 plants for food industries, two chemical factories, 26 ceramics plants, 20 steel factories, 33 plants for metal manufacturing and fabrication, 26 plants for non-ferrous metallurgy, and 16 paper-pulp mills. Aomori Prefecture and the city of Hachinoe had cooperated on control and prevention plans and on establishing standards and enforcement plans, since 1965. In June 1965, six air pollution monitoring stations were installed and four more were added in September 1968. Settling particles are measured by deposit gauges; sulfur dioxide by the lead dioxide and para rosanilin methods and automatic measuring recorders, suspended particulates by hi-volume air samplers, digital dust counters, tape air samplers, and automatic measurement recorders; and wind direction and velocity by automatic self-recording anemometers. Soot measurements shows that between 1965 and 1968, the index increased from 6.2 tons/sq km to 8.4 tons, 11.2 tons, and finally 10.8 tons. Sulfur dioxide measurement was 0.22 mg/day/sq cm in 1965, 0.35 mg in 1966; 0.48 mg in 1967, and 0.37 in 1968. Industrial areas and adjacent areas showed the highest measurements.

44735

DeVoss, Charles R.

ANNUAL REPORT DIVISION OF AIR POLLUTION CONTROL DEPARTMENT OF PUBLIC SAFETY CITY OF COLUMBUS, OHIO 1971. Columbus Dept. of Public Safety, Ohio, Division of Air Pollution Control, 32p., 1971.

Columbus, Ohio is relatively free of major air pollution problems. The city will have the responsibility early in 1972 for enforcement of the State Air Pollution Control Board standards by the final compliance date of July 1, 1975. On seven days in 1971, Columbus was affected by the odor from a kraft paper mill 45 mi south of the city. This is compared with 16 days the previous year. Air pollution alerts were in effect because of air stagnation for 16 days during 1971. This was not indicated on the city's coefficient of haze instrument. Dust fall increased slightly to 17.7 T/sq mi/mo probably as a result of less rainfall. Sulfur dioxide in the ambient air was well below State and Federal standards. Suspended particulates were higher than Federal standards at two locations and lower at the third. Nitrogen dioxide and oxidant were higher than the standards but carbon monoxide was lower. Upon adoption of the ordinance, industry will be required to comply by permit.

E. ATMOSPHERIC INTERACTION

00952

A. C. Harkness and F. E. Murray

GAS PHASE OXIDATION OF METHYL SULFIDE. Preprint. (Presented at the 59th Annual Meeting, Air Pollution Control Association, San Francisco, Calif., June 20-25, 1966, Paper No. 66-58.)

Methyl sulfide and oxygen react explosively at temperatures as low as 210 degrees. At 195 degrees, the nonexplosive reaction exhibits an initiation stage and a main stage. The rate of the main stage as determined from pressure-time curves is linearly dependent on initial oxygen pressure, but substantially independent of initial methyl sulfide pressure. The activation energy of the main stage is 42 kcal/mole. The extent of the initiation stage is reduced by increasing oxygen pressure. The main oxidation products are sulfur dioxide and carbon monoxide. Even with an excess of oxygen not all methyl sulfide reacts. (Author abstract)

25338

Weather Wing (7th), McChord AFB, Wash., Detachment 5

TERMINAL FORECAST REFERENCE FILE. 107p., Feb. 25, 1970. 3 refs. NTIS, DDC: AD 709209

This reference file discusses factors affecting the weather at McChord AFB, Wash. It was compiled to provide a written record of local forecasting information and problems, to serve as a ready reference for local forecasting techniques and climatological data, and to acquaint newly assigned forecasters with pertinent weather phenomena peculiar to the local area and with information accumulated through study and experience at the station. The location and topography of the area are described, and the seasonal weather features are discussed. Smoke, sometimes combined with haze, is quite common when an inversion is present. A copper smelter and a pulp mill in the area are major smoke sources with lesser amounts emitted from an aluminum plant and an industrial area. Three asphalt plants in the area contribute to fog problems. Significant weather phenomena in the region are discussed, including: cyclones, clouds, thunderstorms, wind, and visibility restrictions. Climatic aids are presented in the form of temperature means and extremes, precipitation statistics, wind rose, and ceiling or visibility figures. Objective methods for forecasting various weather situations are considered. A series of weather forecasting problems and their solutions are presented for the area surrounding McChord AFB.

31865

Weather Squadron, 15th, Charleston AFB, S. C., Detachment 3

TERMINAL FORECAST REFERENCE FILE, CHARLESTON AFB, SOUTH CAROLINA. 47p., Jan. 1971. 1 ref. NTIS, DDC: AD 718120

Factors affecting the weather at Charleston Air Force Base, South Carolina were discussed. Location and topography weather controls, climactic aids, and local forecast studies were included. The major air pollution source is a paper mill located about three miles east of the base. Under stable atmospheric conditions, the smoke shows no tendency to diffuse and actually forms a streamer visible for many miles. From the surface to 500 ft, the average wind is from an 80 degrees to 100 degrees in direction. With a low inversion present, visibility generally is reduced to three quarters of a mile to one and one half miles. When the inversion breaks, visibility increases to four miles or greater, depending on the wind and convective currents. A second smoke source is the Stark Industrial area on the bank of the Ashley River, three miles southeast of the base. This smoke has the effect of lowering visibility to about five miles when the lower 2000 to 3000 feet of the atmosphere is very stable and a sea breeze is blowing. Measurements taken include cloud height, visibility, wind direction, temperature, and pressure. Major and minor synoptic patterns for the four seasons were discussed. A thunderstorm study for the Charleston Air Force Base was also presented.

37091

Wright, R. H.

THE DISSEMINATION OF ODORS FROM KRAFT MILL SMOKE STACKS. Pulp Paper Mag. Can. (Quebec), 56(5):131-134, April 1955. 14 refs.

Recent developments in the field of black liquor oxidation combined with measures to absorb digester gases show that the release of kraft mill malodors can be very materially reduced. There is, however, a small amount of residual odor, mainly associated with the stack gases from the recovery plant. The logarithmic relation between concentration of odorant and smell intensity is an obstacle to complete odor elimination, but a very large reduction in the area of the affected territory can be expected. The mathematical theory of smoke dispersion as developed by Sutton is applied to the problem of odors from the stack gases, and the effect of the different variables is shown in a series of curves. Very tall chimneys are not in themselves a practical solution to the problem, and would be justified only under certain special conditions and in conjunction with other measures to treat the stack gases. (Author abstract modified)

39112

Hastings, L., R. Freitag, and A. Smith

FALLOUT OF SODIUM SULPHATE NEAR A KRAFT MILL. Atmos. Environ., 6(4):241-246, April 1972. 3 refs.

The rate of fallout of sulfate in the form of sodium sulfate was determined in the vicinity of a kraft mill. Snow cores of approximately 10 cm diam which extended from the surface of the snow to the soil beneath, and samples from a surface layer no more than 8 cm were taken at the 28 sites near the mill. Core samples alone were taken at the 30 other sites. These samples which weighed about 1 kg each were melted, filtered, and analyzed for sulfate concentration using a turbidimetric method. The rate of fallout decreased with increasing distance from the mill. The difference between the concentration determined by taking surface samples and core samples is mentioned. Samples taken after May 1 along the West and North transits predict a much lower rate of fallout than the samples taken in colder weather. This indicates that as the snow begins to melt, the sodium sulfate is able to escape and determination of the concentration after an extended warm period will not yield a meaningful rate of fallout.

F. BASIC SCIENCE AND TECHNOLOGY

01784

D.F. Adams, R.K. Koppe, W.N. Tuttle

ANALYSIS OF KRAFT-MILL, SULFUR-CONTAINING GASES WITH GLC IONIZAION. J. Air Pollution Control Assoc. 15, (1) 31-3, Jan. 1965

The technique includes the use of two chromatographic columns in series to separate O2, N2,CO,CO2, H2O, H2S, SO2, and CH3SH. Column 1, containing Triton 45 on Chromosorb, separates H2O, H2S, SO2 and CH2SH. Column 2, packed with Molecular Sieve, separates O2, N2, CO2. The conditions required to obtain adequate sensitivity and separation are discussed. (Author abstract)

05385

Martinez, S. E.

SUGAR CANE BAGASSE SHIFTS FROM A WASTE FUEL TO BASIC RAW MATERIAL. Power 108, (1) 52-5, Jan. 1964.

Most sugar cane producing countries have discovered that to improve their economy, their own paper products can be produced with available vegetable raw materials, such as bagasse. Sugar cane plantations are not only in existence, but the sugar cane is a yearly crop, providing abundant raw material from the very first year of operation. Equivalent fuel cost is the largest single factor in determining cost of bagasse delivered to a pulp mill. When this cost is reasonable and proper methods are adopted for depithing, handling, storing and transporting the bagasse, there is no doubt that this raw material can be delivered to the pulp mill at a favorable price. When another fuel is substituted for bagasse the boiler furnaces usually must be rebuilt, or new boilers must be purchased to obtain high boiler efficiencies. These investments are charged against the actual cost of the bagasse produced. Oven dry bagasse has a gross calorific value of about 8200 Btu per lb. Bagasse with 50 percent moisture has a gross heating value of about 4400 Btu per lb. Since efficiency of bagasse boilers is about 55 percent, this represents a net heating value of only 2400 Btu per lb for fresh bagasse. If we substitute Bunker C oil (18,000 Btu per lb) and use a boiler efficiency of 80 percent, the net heating value equals 14,000 Btu per lb. This means one ton of fuel oil replaces about 6 tons of fresh bagasse, or 3 tons of OD bagasse. If the substitute fuel happens to be coal of 12,000 Btu per lb and we consider a boiler efficiency of 78 percent, net heating value for a pound of coal will be 9370 Btu per lb. This means one ton of OD bagasse (burned at 50 percent moisture content) equals 0.53 tons of coal. If we consider natural gas with gross heating value of 1000 Btu cu ft, it turns out that one short tone of OD bagasse (burned at 50 percent moisture content) equals 12,000 cu ft of natural gas. Conclusions among the various agricultural fibers used for pulp, sugar cane bagasse has the greatest promise to become a major fiber for thw world's pulp and paper industry. Every sign points to bagasse playing an important role in the phenomenal expansion of the pulp and paper industry, which will take place in the immediate years ahead.

06719

Harkness, A. C. and F. E. Murray

GAS PHASE OXIDATION OF METHYL MERCAPTAN. Intern. J. Air Water Pollution, Vol. 10, p. 245-251, 1966. 8 refs.

The reaction between methyl mercaptan and oxygen in the gas phase has been examined in the temperature range 201 to 275 C. Sulfur dioxide is the chief product of the reaction, being formed together with methane at the start of the reaction. Other products of the reaction are carbon monoxide, carbon dioxide, hydrogen, formaldehyde and methanol. In the presence of excess oxygen, complete conversion to sulfur dioxide is obtained quickly at 275 C. At lower temperatures and lower oxygen content much of the sulfur remains unaccounted for. In confirmation of previous work the rate of reaction was found to be strongly accelerated by oxygen and to be inhibited by mercaptan.

09498

J. E. Landry

THE EFFECT OF A SECOND ORDER CHEMICAL REACTION ON THE ABSORPTION OF METHYL MERCAPTAN IN A LAMINAR LIQUID JET. Thesis (Ph.D), Louisiana State Univ., Baton, Rouge, Univ., Microfilms, Inc., 1966, 176p.

A versatile gas absorption device, called a laminar liquid jet, was fabricated to study the diffusion coefficients, mass transfer coefficients, and the kinetics of absorption with chemical reaction The laminar liquid jet was chosen to obtain the basic absorption data on the methyl mercaptan-sodium hydroxide system, because its unique fluid dynamic and operating characteristics allow the use of the penetration theory for the description of the process. The absorption data measured with the laminar jet can be analyzed to determine reaction rates for a postulated reaction mechanism. The diffusion coefficients of carbon dioxide, sulfur dioxide, and methyl mercaptan in water at 25 deg. C. were measured. The gas absorption rates in the liquid jet follow the penetration theory results over the studied contact time range of 2.5 to 30 milliseconds. The measured values of the diffusion coefficients were comparable with repotted results. The absorption of methyl mercaptan in aqueous solutions of sodium hydroxide, as measured in the laminar liquid jet apparatus, were correlated by the penetration theory solutions for an infinitely fast irreversible reaction. The diffusion of the hydroxyl ion determines the effect on the mass transfer rate, which would differ significantly if the sodium hydroxide diffused as a molecular specie with its salt diffusivity. The reaction of the dissolved methyl mercaptan with the hydroxyl ions is a very fast second order irreversible reaction with a forward rate constant in the order of 100,000 liters/gram-moles-second. The kinetics of this equation was inferred by extension of the penetration theory solutions in the parametric range studied. The absorption of dilute gas solutions of methyl mercaptan in aqueous sodium hydroxide contacted in a packed absorber was predicted by a method of calculation based on the penetration theory. Knowing the reaction kinetics and the physical absorption constants the height of chemical absorbers can be calculated.

10308

Robert K. Koppe, and Donald F. Adams

GAS-PHASE CHLORINATION OF KRAFT PULP MILL GASES. TAPPI, 51(5) 193-195, May 1968. 12 refs.

Gas-phase chlorination of gases from kraft pulp mills appears to be of limited value as a means of odor reduction. In laboratory experiments, gas samples from the recovery furnace, batch digester, multiple-effect evaporator, and lime kiln of a mill were charged with known volumes of chlorine gas and the reactions were recorded by gas chromatography. The chlorine oxidized the methyl mercaptan in the gases to dimethyl disulfide but did not change the concentrations of hydrogen sulfide or dimethyl sulfide in the samples. Complete elimination of the methyl mercaptan apparently is possible if adequate chlorine doses are added. However, the odor reduction effected in the total gaseous effluent would probably not be sufficient to justify use of this process on a plant scale. (Authors' Abstract

12662

W. T. McKean, Jr., B. F. Hrutfiord, K. V. Sarkanen

KINETICS OF METHYL MERCAPTAN AND DIMETHYL SULFIDE FORMATION IN KRAFT PULPING. Tappi, 51(12):564-567, Dec. 1968. 10 refs.

Earlier rate studies on the formation of methyl mercaptan and dimethyl sulfide in kraft pulping were repeated under carefully controlled conditions. While the rate data obtained were in good agreement with earlier results, somewhat higher values were obtained for the rate constant of dimethyl sulfide formation (k2) at temperatures above 160 degrees C. This difference in results was traced to pH effects. It was possible to demonstrate that the rate of dimethyl sulfide formation is directly proportional to mercaptide concentration, while un-ionized mercaptan does not react with lignin methoxyl groups. As a consequence, the alkali charge in kraft pulping has a definite influence on the ratio of mercaptan to dimethyl sulfide that are formed in the cook. Noncondensibles escaping from the blow gases of mills cooking to alkali-exhaustion (-pH 10.5) are therefore more obnoxious than those from mills maintaining adequate residual alkalinity. Sufficient actibe alkali charge is therfore a recommended practice for older installations. (Author's Abstract)

13010

Aurell, Ronnie and Nils Hartler

KRAFT PULPING OF PINE. I. THE CHANGES IN THE COMPOSITION OF THE WOOD RESIDUE DURING THE COOKING PROCESS. Svensk Papperstid., 68(3):59-68, Feb. 1965. 48 refs.

The changes in the chemical composition of the wood residue during kraft cooking of pine wood were followed for 15.75 and 25%, charges of effective alkali with and without the addition of 0.5% sodium borohydride. At temperatures below 100 C, 30-40% of the alkali charge was consumed in the initial phase of the cook. The removal of lignin and carbohydrates was small during this phase. Between 100 and 150 C, apart from the addition of borohydride, there was only an insignificant decrease in the xylan yield. Without addition of borohydride, 70% of the original amount of glucomannan disappeared from the solid phase whereas an addition of borohydride resulted in a considerably smaller loss of glucomannan. Lignin removal predominated at temperatures higher than 140-150 C. By the time the maximum temperature, 170 C, was reached, 50% of the lignin had gone into solution. At the maximum temperature, the removal of xylan as well as that of glucomannan was gradually retarded and the residual amounts became comparatively stable. This was also applicable to lignin, even if less pronounced. The chief difference between the 15.75% and 25% charges of effective alkali was that, in the former case, the xylan yield was considerably higher and the glucomannan yield somewhat smaller, resulting in an approximately 1% higher pulp yield. The addition of borohydride resulted in a considerable increase in the glucomannan yield and a small decrease in the xylan yield with a net effect of about 3% higher yield. Chemical composition and DP was determined on xylan samples isolated from the pulps. (Author abstract modified)

13012

Wilder, Harry D. and Edward J. Daleski, Jr.

KRAFT PULPING KINETICS. I. LITERATURE REVIEW AND RESEARCH PROGRAM. Tappi, 47(5):270-275, May 1964. 37 refs.

A quantitative description of the rates of removal of the various wood components during alkaline pulping is important to any attempt at design and control of commercial digesters. The complex physical and chemical structure of wood, coupled with our lack of understanding of liquor equilibria, make such a description rather difficult. This review is the first step in a program designed to provide this quantitative description. The literature is reviewed in terms of the five steps normally important in hererogeneous reaction systems. It is concluded that the effects of the two transport steps are negligible under commercial conditions when chips of 2-mm thickness or less are employed and when the liquor alkali is not depleted. When transport is important, a diffusion model probably can account for the observed pulp nonuniformities. The moving interface model of Nolan is but a limiting case of the diffusion model. Sorption and desorption steps do occur, but their importance is not understood. The chemical reaction step is most important. Sulfide and hydroxide act directly during delignification, but their roles in carbohydrate removal are much less clear. Delignification rate is relatable to temperature through the Arrhenius equation. Apparently, delignification by alkaline solutions need not be considered as a lignin surface reaction; lignin is an amorphous material and is accessible to alkaline reactants. Consumption of alkali is probably related to the extent of carbohydrate removal, while sulfide consumption is a function of degree of delignification. (Author abstract modified)

13082

Camacho, T. F.

SPECIFIC ION ELECTRODE FOR MONITORING MILL STREAM SODA LOSSES. Southern Pulp Paper Mfr., 30(6):96, 98-101, June 10, 1967. 2 refs. (Presented at the meeting of the S.E. Sect. Tech. Assoc. of the Pulp and Paper Industry, Jacksonville, Fla., Jan. 20-21, 1967).

In order to improve monitoring of soda loss in washed pulp and mill effluent streams, a glass electrode specific towards sodium ions was evaluated. Control methods now used at various stages of the process are discussed. They include flame spectrophotometry and relating conductivity to soda content. The experimentally determined relationship between the sodium electrode and flame spectrophotometer showed excellent correlation with a buffered sample and good correlation with decker pulp discharge. The sodium electrode was found to be as accurate as the flame spectrophotometer and less complicated to run. Once the sodium electrode test method for stock cleanliness is shortened and the accuracy of the sample preparation steps is improved, implementation on a plant scale will be proposed.

13185

Lenz, B. J. and E. F. Kurth

HYDROTROPIC PULPING OF THE BARK FROM DOUGLAS-FIR AND THE PROPERTIES OF THE RESULTING PHENOLIC ACIDS. Tappi, 46(1):28-31, Jan. 1963. 12 refs.

The ability of various hydrotropic solutions to remove the bark phenolic acids from the bast fiber component of Douglas-fir bark was ascertained and compared the properties of the resulting phenolic acids with that extracted by aqueous sodium hydroxide solution. Pulping ability of several different hydrotropic solutions was compared at temperatures ranging between 120 to 180 C and with liquor-to-fiber ratios ranging between 8:1 to 14:1. From those tested, sodium cymenesulfonate, sodium ethylbenzene sulfonate, and sodium xylenesulfonate had the best hydrotropic effect on the bast fibers. Low pH liquors increased the rate of carbohydrate removal but did not increase the rate of phenolic acid removal from the fibers. High temperatures increased the solubility of the bast fibers but did not aid in selectively removing the bark phenolic acid. None of the hydrotropic solutions was as effective as dilute sodium hydroxide solution for solubilizing the phenolic acid material. Under the conditions studied, the hydrotropic solutions were not good pulping agents for bark. They were not selective in their removal of bark phenolic acids nor did they produce bark phenolic acids which were significantly different from that obtained with sodium from the hydroxide extraction. Most of the bark phenolic acids recovered from the hydrotropic solutions on dilution with water had similar properties. A comparison of the hydrotropic and the sodium hydroxide phenolic acid products indicated they were very similar but not identical in nature. The phenolic acid preparation obtained at the 120 C extraction from the bast fibers had a 6:1 ratio of phenolic hydroxyl group to carboxyl group content. All of the other preparations had a ratio of 4:1. There were only slight differences in the paper chromatograms, methoxyl content, and ultraviolet spectra of the hydrotropic and sodium hydroxide bark phenolic acid preparations and no appreciable difference in their infrared spectra. (Author abstract modified)

13186

Kenaga, D. L., W. A. Kindler, and F. J. Meyer

STUDIES OF ADSORPTION OF CATIONIC POLYELECTROLYTES ON PULP USING STREAMING CURRENT DETECTION. Tappi, 50(7):381-387, July 1967. 11 refs. (Presented at the 52nd Annual Meeting, Tech. Assoc. of the Pulp and Paper Industry, New York, Feb. 20-23, 1967).

A new instrument, the Streaming Current Detector (SCD), offers a technique to measure the capacity of a pulp to adsorb cationic materials such as those used to give wet strength. The SCD can also be used to determine the relative ionic strength of polyelectrolytes. In the case of cationic strength agents, the ionic strength of the polymer correlates with the strength increase observed in treated paper. Operating on the streaming current phenomenon, the SCD depends upon adsorption from the effluent to establish an ionic double layer on the operating surfaces of the instrument. The data indicate that the charge characteristics of the pulp-polyelectrolyte-water system can be related to the pulp-polyelectrolyte-water-SCD system. It is shown that adsorption of cationic strength agents on pulp occurs by a dual mechanism. Primary adsorption occurs to the point of charge neutrality and is thought to be an ion exchange mechanism. Secondary adsorption is thought to be due to van der Waals' forces or hydrogen bonding. The maximum quantity of a cationic polyelectrolyte adsorbed on pulp by the primary mechanism is pH-dependent: the more basic the solution the more adsorbed and, hence, the greater the strength of the treated paper. However, the increase in strength per unit of additive to the point of charge neutrality is similar at all pH levels and, therefore, is independent of pH. Secondary adsorption produces some increase in strength which appears to vary with additive and pH. Maximum efficiency of retention is observed at the point of charge neutrality. (Author abstract)

13187

Fuller, Robert R.

THOUGHTS ON THE LIQUOR CYCLE AND CAUSTICIZING. Southern Pulp Paper Mfr., 29(1):70-71, 74, 76, 78, Jan. 10, 1966.

In addition to sodium hydroxide and sodium sulfide, kraft cooking reactions are influenced by sodium sulfate, sodium carbonate, thiosulfate, and polysulfide components. The practice of reporting green and white liquor compounds in terms of sodium monoxide, as followed by the Forest Products Laboratory tests, does not produce accurate analyses of kraft cooks. Not only cooking and washing operations, but other steps in the recovery cycle will vary as the components vary in relation to each other and in total. The dilution used at the digester and the ability of the total solution to absorb more solids are other operating variables. The fiber slurry is also affected by residual chemicals. The key to controlling these variables is the efficiency of the causticizing operation through which sodium carbonate is converted to sodium hydroxide. Concentration has been found to be the major factor controlling conversion efficiency. Hydroxide and sulfite will reduce the efficiency to the extent that they contribute to the concentration, and as they affect the equilibrium. Excess lime and good lime slaking improve efficiency. It is suggested that attainable laboratory conversions of sodium carbonate to hydroxide should be investigated under varying conditions of time and excess lime. The economics of the causticizing system should also be studied.

13188

Pettersson, Sven and Olof Samuelson

URONIC ACIDS IN SULFITE SPENT LIQUOR FROM SPRUCE. Svensk Papperstid., 70(15):462-468, Aug. 15, 1967. 24 refs.

The following uronic acids were isolated from sulfite spent liquor by means of chromatographic separations on anion exchange resins: 2-0-(4-0-methyl-alpha-D-glucopyranosyluronic acid)-D-xylose, 4-0-methyl-D-glucuronic acid, 2-0-(alpha-D-galactopyranosyluronic acid)-L-rhamnose, 6-0-(beta-D-glucopyranosyluronic acid)-D- galactose, 2-0-(alpha-D-glucopyranosyluronic acid)-D-xylose, D-galacturonic acid, and D-glucuronic acid. The first two acids were present in larger amounts than the other species. The total amount of uronic acids in the liquor (calculated as hexuronic acids) was about 1 g/L. This indicates that the major part of the uronic acids removed from wood during cooking are destroyed. The increase in the content of fermentable sugars which can be gained by hydrolysis of the biouronic acids present in the spent liquor is negligible. (Author abstract modified)

13189

Trout, Paul E.

MAGNESIUM-BASE SEMICHEMICAL PULPING FOR CORRUGATING MEDIUM PRODUCTION. Tappi, 51(3):43A-47A, March 1968. 13 refs. (Presented at the 52nd Annual Meeting, Tech. Assoc. of the Pulp and Paper Industry, New York, Feb. 19-23, 1967.)

Studies were conducted to determine if the quality of a corrugating medium made by a commercial magnesium-base semichemical process could be competitive with that made by the regular soda-base neutral sulfite semichemical (NSSC) process. The magnesium-base semichemical liquor was prepared by batch sulfitation of magnesium hydroxide slurry. Cooking of mixed hardwoods was carried out in a conventional continuous digester. Process equipment was severely eroded by the liquors, and it is doubtful that a commercially operable neutral magnesium-base semichemical pulping process can be developed. At the same time, magnesium base pulps were found to require lower chemical ratios, lower cooking temperatures, and shorter cooking times than soda-base NSSC pulps. The magnesium-base pulps and corrugating mediums had lower strength properties than the comparable sodium- base products. However, these differences did not adversely affect corrugated container performance.

13190

Simonson, Rune

AUTOMATED METHOD FOR DETERMINATION OF HEMICELLULOSE IN THE PRESENCE OF LIGNIN. Svensk Papperstid., 70(17):537-539, Sept. 15, 1967.

A method is described for the determination of small amounts of hemicellulose in the presence of acid-insoluble lignin using Technicon's Auto Analyzer. The first reaction step involves hydrolysis of the hemicellulose in hydrochloric acid solution. In the second step, precipitated lignin is removed by passing the hydrolyzed sample through a dialysis cell. The hydrolysis products that pass through the membrane react with orcinol in the final step to give a color whose intensity is determined colorimetrically. The influence of lignin upon the chart reading and the reproducibility of the determination are discussed. (Author abstract)

13236

McIntosh, D. C.

TENSILE AND BONDING STRENGTHS OF LOBLOLLY PINE KRAFT FIBERS COOKED TO DIFFERENT YIELDS. Tappi, 46(5):273-277, May 1963. 10 refs. (Presented at the Symposium on Interfiber Bonding, Div. of Cellulose, Wood, and Fiber Chemistry, Am. Chem. Soc. Atlantic City, N. J., Sept. 13, 1962).

Loblolly pine springwood and summerwood chips were cooked to different yields and further delignified by treatments with peracetic acid-sodium borohydride in order to separate the fibers. Tensile and bonding strengths of individual fibers were then determined. Summerwood fibers were superior to springwood fibers in tensile strength per unit cross-sectional area and in bonding strength per area available for contact. Individual summerwood fibers showed a rapid decrease in strength per fiber at high yield levels, but based on cross-sectional area of the fiber wall, strength showed no appreciable change until the lower yield levels were reached. Bonding strength was reduced at higher yield levels than fiber strength per cross-sectional area. In contrast, springwood fibers showed a gradual decrease in fiber strength with decreasing yield and were relatively constant in bond strength at different yields. Chemical analysis of summerwood pulps showed a general reduction in lignin content, degree of polymerization (D. P.), and hemicelluloses with reduction in yield. Because of the variables involved, no clear-cut relationship between tensile strength and any one chemical constituent was apparent. However, fiber strength (in grams) showed good correlation with mannan content and D.P. Because the chemical composition and structure of the surface of the fibers is not yet known, any relationship between bonding strength and chemical composition of the pulps is felt to be spurious. (Author abstract modified)

13240

Kesler, Richard B.

ANALYSIS OF ALKALINE PULPING LIQUORS. IV. AUTOMATIC COLORIMETRIC DETERMINATION OF TOTAL AND ACTIVE ALKALI IN WHITE AND GREEN LIQUORS. Tappi, 47(3):167-170, March 1964. (Presented at the 17th Alkaline Pulping Conference, Tech. Assoc. of the Pulp and Paper Industry, Green Bay, Wis., Sept. 23-25, 1963).

Utilizing various modules of the Technicon Autoanalyzer, a method was developed for the measurement of total alkali in kraft white and green liquors. Relatively minor modifications make the same method suitable for measurement of active alkali. The method is based on overneutralization of the liquor sample, followed by colorimetric measurement of excess hydrogen ions through use of a buffered solution of methyl orange indicator. The procedure is suitable for use in the laboratory, where 20 samples an hour can be analyzed, or in the mill or pilot plant, where one or more liquor streams can be continuously monitored. (Author abstract)

13241

Utaka, Giichi, Kyoichi Oku, Hiroshi Matsuura, and Asahi Sakai

BASIC STUDIES ON HARDWOOD TWO-STAGE SULFITE PULPING. BEHAVIOR OF HARDWOOD HEMICELLULOSES DURING COOKING. Tappi, 48(5):273- 281, May 1965. 38 refs.

Single-stage and two-stage pulpings of wide pH range were performed on a mixture of beech and oak, the typical Japanese hardwoods. The pulp properties of both full-chemical and high-yield pulps produced by various pulping procedures were compared and discussed. In addition, the hemicelluloses extracted from the original woods and pulps were analyzed to study the behavior of hardwood hemicelluloses under various cooking conditions. The effect of quantity and chemical structure of hemicelluloses on the pulp yield and pulp characteristics, based upon the analysis of hemicelluloses, is discussed. (Author abstract modified)

13272

Quimby, George R. and Otto Goldschmid

RECOVERY OF LIGNOSULFONATES FROM SPENT SULFITE LIQUORS. (Rayonier Inc., Shelton, Wash.) U. S. Pat. 3,271,382. 4p., Sept. 6, 1966. 3 refs. (Appl. Sept. 26, 1963, 2 claims).

Sufficient quaternary ammonium salt is dissolved in water and added to the spent sulfite cooking liquor at ambient temperature to provide about a stoichiometric ratio of quaternary ammonium salt to lignosulfonate and the mixture is agitated. The concentration of total solids dissolved in the spent sulfite cooking liquor is not critical and can range from about 1 to 50%. The lignosulfonate and quaternary ammonium salt combine to form a dense flocculant which settles within a minute or two after agitation is stopped, leaving the wood sugars and other impurities in solution. The excess solution is then decanted or siphoned off and the precipitated quaternary ammonium lignosulfonate is recovered by filtration or centrifuging, after which it is washed free of impurities with cold water. The washed precipitate is dissolved in an aliphatic alcohol (preferably methanol or 95% ethanol) for separation of quaternary ammonium salt lignosulfonate components and their recovery in pure form. The lignosulfonate is precipitated from the alcoholic solution by the addition of a slight excess of the alcoholic solution of a soluble alkali metal hydroxide or neutral salt, such as NaOH, KOH, NaCl or KCl. The alkali metal lignosulfonate immediately precipitates out in a dense, rapidly settling form and can be easily separated and recovered as a pure material.

13311

Nelson, Peter F.

IDENTIFICATION OF ACIDIC GROUPS IN EUCALYPT NEUTRAL SULPHITE AND PINE BISULPHITE PULPS. Svensk Papperstid., 71(9):369-372, May 1968. 7 refs.

Acids obtained from hydrolysis of eucalypt neutral sulfite semichemical and Pinus radiata bisulfite pulps were analyzed by chromatographic and spectrometric methods. The uronic acids of the two pulps resembled those obtained from three kraft pulps previously studied, but 4-0-methyliduronic acid was absent in the bisulfite pulp and occurred in relatively small amounts in the neutral sulfite pulp. The bisulfite pulp contained much larger quantities of aldonic acids than the neutral sulfite pulp, illustrating the importance of bisulfite ions in end-group oxidation of polysaccharides. Only traces of glucometasaccharinic acids were present in the neutral sulfite pulp, indicating that 'peeling reactions' are less important in neutral sulfite than in kraft pulping. (Author abstract modified)

13318

Sinclair, G. D.

THE EFFECT OF COOKING AGENTS ON WOOD. I. ALKALINE COOKING OF POPLAR WOOD. EFFECT OF STRENGTH AND COMPOSITION. Pulp Paper Mag. Can., 65(11):T-516-T-520, Nov. 1964. 9 refs.

High-yield pulp processes were studied to determine desirable chemical concentrations and what components of wood are affected or removed under mild cooking conditions. Poplar heartwood and sapwood samples were cooked in dilute solutions of NaOH, Na2SO4, and LiOH, with cooks made on five specimens at a time in a one-liter flask fitted with a reflux condenser. Data obtained show the amounts of holocellulose, pentosans, and lignin remaining in the cooked woods and the effects of both cooking time and chemicals on water sorption, weight loss, and wet breaking strength. The wet breaking strength of poplar heartwood was reduced from 292 lbs to 118 lbs after cooking with 8% NaOH for 2 hrs at 100 C. Poplar sapwood had an original strength of 386 lbs; this was reduced to 124 lbs after cooking for 2 hrs with 10% NaOH. The loss in weight during cooking was greater for sapwood than for heartwood, but sapwood sorbed less water than heartwood. Lithium hydroxide reduced the strength of the wood more than the other chemicals and also removed a greater percentage of wood. The more severe cooking removed more holocellulose than pentosans and lignin. It is concluded that there is a relation between the wet breaking strength of wood and the watt-hours of energy per pound needed for refining.

13319

Thompson, N. S., J. R. Peckman, and E. F. Thode

STUDIES IN FULL CHEMICAL PULPING. II. CARBOHYDRATE CHANGES AND RELATED PHYSICAL EFFECTS. Tappi, 45(6):433-442, June 1962. 49 refs.

The chemical nature of various xylan components of black spruce pulps was established by extraction and fractionation experiments with pulps cooked at all pH levels to equal degrees of delignification. All pulps cooked between pH 1.5 and 6 were found to contain a 4-0-methylglucuronoxylan. Full chemical pulps cooked at pH 9 to 11 contained a 4-0-methylglucuronoaraboxylan whose composition resembled the composition of the original polymer of spruce holocellulose. Kraft pulps were characterized by the presence of an araboxylan. Also detected in all pulps, but not isolated, were glucomannan polymers. A galactoglucomannan was identified in alkaline pulps cooked at pH 9 to 12.5. Differences in the nature and the distribution of the hemicellulose components in the various pulps suggests that accessibility of hemicellulose to alkali changes at different pH levels. The hemicellulose contents of the pulps were found to be relatively constant, by the yield of cellulose varied considerably. As indicated by its low yield and low viscosity, cellulose was the least stable component at neutral pH. Three types of carbohydrate degradation occurred during the pulping processes: acid-catalyzed degradation of glycosidic bonds, peeling, and alkaline hydrolysis of glycosidic bonds. A fourth type probably occurs at neutral pH, but its nature is not known.

13342

Grant, J. and S. V. Sergeant

PULP AND PAPER. Rep. Prog. Appl. Chem., vol. 51:525-539, 1966. 72 refs.

This is a selective review of the literature on developments in relatively new fields of the pulp and paper manufacturing industry. It covers approximately the two years ending November 1, 1966. The papers included for review emphasize the following aspects of pulp and paper manufacture: recent new principles and methods involved in pulp manufacture; advances in knowledge connected with the formation of paper on the paper machine; and new developments in the aftertreatment of paper for special purposes. The hot grinding of mixed hardwoods as a means of homogenizing pulp, delignification with drychlorine, and the treatment of groundwood pulps with peracetic acid exemplify developments in pulp production. Studies on the formation of paper by the paper machine include the use of synthetic fibers, alone or together with cellulosic materials; the interactions between water and cellulose materials; the effects of tension drying on the mechanical properties and structure of individual holocellulose pulp fibers; and the treatment of pulp by high consistency refining. Among the aftertreatments of paper are the use of silver-sensitized coatings, bladecoating machines, and polymers for hot melt coatings.

13343

Wenzl, Herman F. J. and O. V. Ingruber

WOOD STRUCTURE AND MOVEMENT OF COOKING LIQUORS IN THE WOOD DURING KRAFT PULPING. Paper Trade J., 150(36):28-31, Sept. 5, 1966. 40 refs.

The microscopic properties of cellulose are known to be strongly influenced by the effect of alkaline solutions on its crystal structure, so it is not surprising that the uneven crystalline structure of wood is further influenced in kraft cooks. However, the solution of various wood components is largely independent of the physical structure of the wood. Pulp properties depend mainly on morphological characteristics and the basic strength of the fibers. Cell wall thickness is an important influence on beating behavior of pulps, while lumen width and fiber diameter affect density, tensile, and bursting strengths. Retention of large amounts of noncellulosic components makes some pulps more resistant to beating. The mechanism by which liquid penetrates wood is complicated due to the variety of movements and forces involved, in addition to the complex capillary structure of wood. The tracheidal fibers of softwoods are more effective in aiding penetration than the ray cells of hardwoods. The penetration of dissolved substances into the wood structure is of special importance in pulping, and liquids possessing swelling properties penetrate wood more rapidly than nonswelling liquids. The permeability by liquids which react chemically with one or more components of the wood shows a strong dependence on time and temperature. The desired isolation of cellulose is an extraction process connected with a chemical reaction of the extraction medium with the substances accompanying the cellulose. Solvents and reagents need to penetrate the capillary structure to reach the cell walls. This penetration occurs in a more or less rapid initial stage through water vapor diffusion and condensation and is followed by capillary rise. In the second stage, final diffusion into the cell walls and swelling occurs.

13344

Nilsson, H. Evert R. and Karl Ostberg

KRAFT PULPING WITH THE ADDITION OF HYDRAZINE. Svensk Papperstid., 71(3):71-76, Feb. 1968. 26 refs.

Reducing agents such as hydrazine increased the yield of kraft cooking. Large doses of hydrazine increased the pulp yield from both pine and spruce by about 10% and from birch by 2 to 4 %, calculated on wood basis. In addition, the pulp brightness was improved up to about 15 %. Exploratory cooks with addition of pyrogalloll and dithionite were also performed, but with less effect. It has been found that the higher pulp yield mainly originates from a stabilization of glucomannan in pine and spruce, and of cellulose in birch. This is in accordance with previous experience from kraft cooking of pine and spruce with addition of sodium tetrahydridoborate. Further preservation of birch xylan might have been obtained with a lower white liquor charge. Laboratory beating and paper testing of the pine and spruce kraft pulps showed the expected deviations from the normal kraft pulp properties. Thus, the higher yield pulps obtained by the addition of hydrazine possessed slower beating response, slightly lower tear strength and comparatively unchanged tensile and burst strength. (Author abstract modified)

13346

Orsler, R. J. and D. F. Packman

THE DETERMINATION OF LIGNIN IN SULPHITE PULPING LIQUORS. Svensk Papperstid. (Stockholm), 67(21):855-859, 1964. 11 refs.

The lignin content of spent bisulfite pulping liquors was determined by ultraviolet absorption measurements and the method was developed so that the course of delignification could be followed during two-stage cooks of the Stora type. The relative advantage of measuring absorption at 205 millimicrons and 280 millimicrons are assessed. It was found that measurement at 200-205 millimicrons was satisfactory for liquors containing less than 5 g/L total SO2 even when they contained considerable amounts of hydrolysis products such as furfural. For liquors containing more than 5 g/L of SO2 but less than 0.5 g/L furfural the 280 millimicron region was preferable. Liquors containing more than these quantities of both interfering substances could be satisfactorily measured at 200-205 millimicrons after an oxidation and precipitation treatment to remove all sulfites and SO2. (Author abstract modified)

13347

Aurell, Ronnie

THE EFFECT OF LOWERED PH AT THE END OF BIRCH KRAFT COOKS. Svensk Papperstid. (Stockholm), 66(11):437-442, 1963. 12 refs.

For kraft cooking of birch, a certain increase in pulp yield could be obtained at high alkalinity - 22.5% effective alkali - without lignin sorption, by a moderate lowering of the pH at the end of the cook. This increase in yield was 1 - 1.5% based on wood. At lower alkalinity - 17.5% effective alkali - no effect was obtained. If the delignified chips and the black liquor were cooled together approximately 1% higher yield was obtained at the higher alkalinity compared with hot drawing-off of the black liquor. At lower alkalinity this effect could not be obtained. Carbohydrate analyses on the pulps indicated that the yield increase mainly consisted of xylan. As long as lignin sorption did not take place the brightness of the pulp was not affected. There could not be established any differences in beating and strength properties. (Author abstract)

13350

Jensen, W., B. C. Fogelberg, K. Forss, K-E. Fremer, Monica Johanson

SULFUR DISTRIBUTION IN AN ACID CALCIUM BISULFITE COOK. Tappi, 48(3):174-180, March 1965. 20 refs. (Presented at the First International Sulphite Pulping Conference sponsored jointly by the Tech. Assoc. of the Pulp and Paper Industry and Tech. Sect., CPPA, Chicago, June 16-18, 1964).

The reactions of the bisulfite ions in an acid calcium bisulfite cook were studied by labeling the cooking acid with Na2S(35)O3 and by gel filtration of the resulting radioactive spent liquor. The analyses revealed that three fourths of the sulfur in the cooking liquor reacted to form only compounds containing 'loosely bound' sulfur dioxide or did not react at all. Only about 13% of the sulfur reacted to form organic compounds containing firmly bound sulfur. It could be shown that of this sulfur about 66% was bound to the lignin whereas the rest was bound to about a dozen lignin-like compounds and nonaromatic compounds. It was found that there are equivalent amounts of calcium and sulfur in at least the low-molecular weight calcium lignosulfonates and it was also found that the sulfonation of lignin is accompanied by the formation of reducing groups. The large amounts of sulfur bound to wood components other than lignin show that bisulfite ions participate in many unknown side reactions in an acid bisulfite cook. (Author abstract modified)

13351

Croon, Ingemar

SOFTWOOD SULPHITE PULPS IN INCREASED YIELD BY THE ALKALI- SULPHITE (A-S) METHOD. Svensk Papperstid. (Stockholm), 66(1): 1-5, 1963. 19 refs.

A pretreatment of wood chips with alkaline solutions (5-50 g NaOH/L), at temperatures below 70 C for 30 - 90 min gives 2 - 7% (calculated on the wood) higher yield in the succeeding digestion with sulfite acid, than that from a digestion without the pretreatment. The defibration point of the alkali acid sulfite pulps is reached in the yield region 68-70%, compared to 58-60% for the conventional one-stage sulfite pulps. The glucomannan content of the pulp increases, and it is assumed that the main reason for its stabilization consists of the deacetylation effect of the pretreatment. Full yield gain is obtained whether the chips are digested directly after the pretreatment or washed and stored in moist or dried from and digested later. These results illutrate the great flexibility of the alkaline-acid type of two-stage cooking. (Author abstract)

13362

Annergren, Goran and Ake Backlund

CONTINUOUS SULPHITE COOKING. Pulp Paper Mag. Can., 67(4):T220- T224, April 1966. 8 refs.

Continuous sulfite cooking has been studied at the Billerud Experimental Pulp Mill in Sweden. The cooking trials were carried out in downflow Kamyr digesters of two different designs. A conventional Kamyr digester was used with good results for continuous cooking of high-yield bisulfite pulp. In the cooking of bleachable-grade bisulfite pulp, however, the decomposition of the cooking chemicals accelerated and a 'burnt' cook resulted. The uncontrolled decomposition was probably caused by thermal liquor flows in the digester. A modification of the digester, to a system incorporating an inclined top separator and carrying full cooking temperature at the top, eliminated the thermal flows and thereby the risk for uncontrolled cooking-liquor decomposition. The new digester system has successfully been used for continuous cooking of bleachable-grade bisulfite pulps on softwoods as well as hardwoods. It has also proved to be well suited for a two-stage sulfite process with a neutral first stage and an acid second stage, as well as a modified soluble-base, acid sulfite process for rayon-grade pulps. Typical operating conditions and pulp quality data are reported. (Author abstract modified)

13379

Rioux, J. P. and F. G. Hurtubise

DETERMINATION OF CHLORIDE IONS IN PULP AND PAPER. COMBINATION OF OXYGEN FLASK AND AUTOMATIC POTENTIOMETRIC TITRATION TECHNIQUES. Tappi, 48(1):11-14, Jan. 1965. 9 refs. (Presented at the 15th Testing Conference, Tech. Assoc. of the Pulp and Paper Industry, Boston, Sept. 29-Oct. 1, 1964).

A rapid and precise method for the potentiometric titration of chloride ions in pulp has been developed. The pulp is ashed by the oxygen flask technique. The chloride ions are absorbed in dilute sodium hydroxide, the solution is evaporated to dryness, and the residue is redissolved in a small amount of dilute nitric acid. The solution is diluted with acetone and titrated with 0.0025M silver nitrate using a potentiometric titrator- recorder, and an Ag-AgCl-glass electrode system. Procedures for total chloride and water soluble chloride are described. The procedure for total chloride was applied to water and methanol- benzene extracted pulps to determine the lignin-bound chlorine, the resin-bound chlorine being calculated by difference. The method was examined for recovery and reproducibility. The range is 5 to 1000 ppm on pulp. A total chloride determination (including ashing) can be performed in 30 min. (Author abstract)

13382

Hartler, Nils

THE EFFECT OF CHIP DAMAGE ON THE FIBRE BONDING OF ACID BISULPHITE PAPER PULPS. Svensk Papperstid, 66(10):412-417, 1963. 30 refs.

The effect of chip damage on fibre bonding was investigated by comparing pulps in one case from damaged and undamaged halves of technical chips and in another from pressed and unpressed wood. It was found that neither the specific energy of bond failure according to Nordman nor the bonded area, as measured by the optical contact methods, are affected as far as acid bisulfite paper pulp fibres are concerned. The implication of the findings for the strength of the resultant paper is discussed. (Author abstract modified)

13384

Schoon, Nils-Herman

THE REACTION BETWEEN THIOSULPHATE AND WOOD DURING SULPHITE COOKING II. Svensk Papperstid. (Stockholm), 65(23):965-977, Dec. 15, 1962. 16 refs.

The formation of thiosulfate and organic excess sulfur and also the formation of sulfur via polythionates were calculated for a series of acid hydrogen sulfite cooks (1.00, 1.36% Na20, 6% total-SO2, maximum temperature 135 and 148 C) with various amounts of thiosulfate added to the cooking acid. The calculations also included hydrogen sulfite cookings (1.92% Na20, 3.96% Na20% total-SO2, maximum temperature 155 C). In all cooks, thiosulfate was formed primarily from the reactions between aldoses and hydrogen sulfite. However, the formation of thiosulfate via the reactions between the polythionates and hydrogen sulfite (disproportionation of hydrogen sulfite) increased at the end of the acid hydrogen sulfite cook while formation via the aldoses and hydrogen sulfite decreased. When cooking acid contains thiosulfate, the thiosulfate concentration decreases rapidly. No corresponding increase in the polythionate concentration is observed at the beginning of these cooks, indicating a considerable formation of organic excess sulfur. The polythionate concentration increases rapidly in the final stage of the cooks due to the high hydrogen ion content. The high concentration suggests that polythionates are formed by other reactions in the presence of wood. In both paper pulp and rayon pulp cooks thiosulfate formation via aldoses and hydrogen sulfite also predominates. (Author abstract modified)

13385

Mannbro, Nils

KRAFT PROCESS LIQUORS FOR SODIUM BASE SULPHITE PULPING. PART 2. PULPING EXPERIMENTS AND DISCUSSION OF ECONOMICS. Svensk Papperstid. (Stockholm), 66(3):95-109, Feb. 28, 1963. 24 refs.

Sulfite cooking acids were prepared from carbonated green and black kraft liquors. Their pulping capacities were compared with pure sodium and calcium sulfite acids by cooks on spruce (Picea abies). All acids contained an equivalent amount of metal cations corresponding to 1.2% combined and with 7.3% total sulfur dioxide. Comparative bleachings comprising chlorination-caustic extraction-hypochlorite stages were applied on the pulps. Results show that green liquor produced either unbleached or bleached pulp possessing properties comparable to those of pulp cooked with pure sodium sulfite acid. Black liquor produced a pulp yield at medium Reynolds number which was competitive with that of the ether sodium-base pulps. However, color and bleachability were inferior. This acid might be fortified with available base to give better results. Replicate runs of calcium - and pure sodium-base cooks and bleaching show that the chlorine consumption of sodium-base pulp is reduced to about 20% of that of the calcium pulp. On equivalent chlorine consumption basis, the yield gain by sodium-base pulping is 5.5%, as calculated on the corresponding yield of calcium-base pulp. The pulping yield and the chlorine consumption should be balanced for optimum process economy. Actually, sodium-base pulp should be cooked to a somewhat lower Reynolds number than calcium-base pulp. Under these conditions, sodium-base pulping of bleached grades, without recovery of the cooking chemicals, was found profitable. With regard to unbleached pulps, there is no justification for the sodium base in conventional sulfite cooking. For high-yield pulping, e.g., newsprint, the bisulfite method is more advantageous. (Author conclusions modified)

13418

Gierer, Josef, Bernard Lenz, and Nils-Hakan Wallin

THE SPLITTING OF ARYL-ALKYL ETHER BONDS IN MILLED WOOD LIGNIN BY WHITE LIQUOR. PART VII. OF A SERIES ON THE REACTIONS OF LIGNIN DURING SULFATE COOKING. TAPPI, 48(7):402-405, July 1965. 14 refs.

Milled wood lignin from Picea abies and varioussus methylated modifications were treated with white liquor at 170 C for different lengths of time, and the resulting materials were analyzed for free phenolic hydroxyl groups. The results show that white liquor splits aryl-ether bonds present in lignin at a higher rate and to a slightly greater extent than 2N NaOH, used as a splitting reagent in a previous investigation of this series (Gierer, Lenz, Noren, and Soderber, TAPPI, 47:233, 1964). The higher rate of aryl-ether splitting by white liquor may be ascribed to the stronger nucleophilicity of the hydrosulfide ions as compared with hydroxyl ions. The more extensive methylether cleavage during sulfate cooking is indicative of this difference. However, the favorable effect of hydrosulfide ions on the splitting of aryl-ether linkages may also be partly expalined by assuming an intermediate incorporation of these ions into lignin at carbon atom adjacent to aryl-ether bonds and an alkaline splitting of the resulting mercapto-alkyl-ether structures via episulfide intermediates. These hypotheses are in accord with model studies which indicate that a possible pathway involves addition of hydrosulfide ions to methylene quinone structures and confirming the ease of splitting mercapto-alkyl-aryl ethers by alkali. (Authors' abstract modified)

13420

Kleinert, Theodor N.

COTTON DEGRADATION BY SODIUM BOROHYDRIDE IN ALKALINE COOKING AT 180 C. Holzforschung, 20(2):43-45, April 1966. 21 refs.

Degradation of cotton cellulose at 180 C in sodium hydroxide solutions with and without additions of sodium borohydride was investigated. Evidence was found that under the conditions of alkaline pulping sodium borohydride had primarily a chain splitting effect upon the cellulose, similar to that observed when reacting cellulose in sodium borohydride solutions at room temperature, although at pulping temperature this effect was to some extent obscured by the strong thermal decomposition of the sodium borohydride. In addition to the cellulose degradation, sodium borohydride reduced and stablized the newly formed end groups resulting in some increase of the cellulose residue compared with that in the blank experiments. Increase of the sodium hydroxide concentration of the liquor at constant sodium borohydride charge increased the chain splitting as indicated by the viscosity drop. Probably, because of the known stabilizing effect of the alkali, increase of the sodium hydroxide concentration delayed the decomposition of the sodium borohydride and thus prolonged its action upon the cellulose. Tentatively, free radical reactions during the action of sodium borohydride upon cellulose are briefly discussed. (Author's summary)

13423

Laver, M. L., D. F. Root, F. Shafizadeh, and J. C. Lowe

AN IMPROVED METHOD FOR THE ANALYSIS OF THE CARBONHYDRATES OF WOOD PULPS THROUGH REFINED CONDITIONS OF HYDROLYSIS, NEUTRALIZATION, AND MONOSACCHARIDE SEPARATION. TAPPI, 50(12):18-622, Dec. 1967. 23 refs. (Presented at the 52nd Annual Meeting of the Technical Assoc. of the Pulp and Paper Industry, New York, N. Y., Feb. 19- 23, 1967.)

An improved method for the determination of the carbohydrates in woood pulps is based upon dissolution in 77.0% sulfuric acid followed by controlled hydrolysis in 3.0% sulfuric acid. The acid is neutralized to pH 5.0 with an aqueous barium hydroxide solution, and the resulting hydrolyzate is carefully concentrated to a syrup. The monosaccharides present are separated by gas- liquid chromatography of their trimethylsilyl ethers. They are determined quantitatively by comparison with myo-inositol, which is added as an internal standard. (Authors' abstract)

13435

Devones, K. R.

SOAP RECOVERY-DOUGLAS-FIR KRAFT OPERATION. Tappi, 46(10):167A-169A, Oct. 1963.

A system used for tall-oil soap recovery from Douglas-fir kraft liquor is described. Initial studies were made to determine the amount of recoverable soap present in the liquor by simple batch phase separations of the soap from the liquor in a 55-gal drum. Optimum retention time is 4 hours, at which recovery efficiency is 90%. Third effects of the multiple effect evaporators result in 30% black liquor solids; This concentration gives a yield of 33 lb of tall oil per ton of kraft pulp. A diagram of a soap recovery system is given, and the skimming-tank operation is explained. Tall-oil soap was found to contain 52% tall oil, 7% black solids, and 39% moisture. Tall oil was analyzed and found to contain 35% fatty acid and 40% rosin acid.

13436

Drew, John

OBSERVATIONS FROM EXPERIMENTAL DATA IN ACIDULATION OF TALL OIL. Tappi, 46(2):128A-129A, Feb. 1963.

The solvent process for extracting tall oil from tall-oil soap involves the introduction of a solvent such as naphtha into the soap skimmings, water, and sulfuric acid. The mixture is then placed in an acidulation reactor. The solvent is recovered by evaporation. It was found that when more black liquor was removed from the soap before acidulation productivity was higher. This reduction was accomplished by the addition of a small amount of water to the soap. The preferred pH value of the mixture is 3.7. Data show that the solvent process improves product quality but that the process is economically unfeasible. The research is being conducted by Glidden.

13437

Villavicencio, Eduardo J., Mario Sierra Rojas, and Salvador Escobar

CONTINUOUS DIGESTING OF CELLULOSIC FIBROUS MATERIAL AT DECREASING PRESSURE WITH MECHANICAL DEFIBERING THEREBETWEEN. (Cia Industri de Ayotla, S.A.) U. S. Pat. 3,238,088. 5p., March 1, 1966. 7 refs (Appl. Dec. 4, 1962, 5 claims.)

A novel process for the continuous production of high-grade pulp from sugar cane bagasse is described. The bagasse is subjected to an initial softening and chemical impregnation step in a saturated steam zone at 366 F and 150 psig. It is then mechanically defibrated at the same temperature and pressure. This is followed by continued exposure to steam at 358 F and 135 psig to complete the refining and cooking of the pulp. The process allows lower temperatures and pressures to be used, which results in a stronger and lighter product. The continuous nature of the process yields a high-grade pulp with a 90% reduction in the quantity of chemicals required for separating the lignin and other non-cellulosic materials from the fiber.

13453

Crowell, E. P. and B. B. Burnett

MICRO DETERMINATION OF ROSIN AND FATTY ACIDS IN TALL OIL. TAPPI, 49(7):327-328, July 1966. 4 refs. (Presented at the 51st Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in New York, N. Y., Feb. 20-24, 1966.)

The standard procedure for the determination of total rosin acids and acid number, ASTM D-803, requires 9 g of sample for single determinations. Therefore, it is not applicable to situations were large quantities of tall oil are not available. Such is the case with samples of crude tall oil from black liquor streams of the kraft pulping process. The boron trifluoride-methanol esterification procedure for selectivity masking fatty acids in the rosin acid determination was investigated and found to be attractive because it is simple to use and has proven applicability to small samples. Gas chromatographic investigation showed that this methylation procedure is selective for fatty acids and is therefore acceptable for this purpose. The minimum sample requirement for the determination of both fatty and rosin acid is 75 mg of tall oil. Acceptable agreement between the ASTM procedure and this micro method was observed for samples with greater than 15% rosin acids. (Authors' abstract)

13462

Viola, G.

HOW RICE AND WHEAT STRAW ARE PULPED IN THE KOCANI MILL IN YUGOSLAVIA. Paper Trade J., 150(24):74-76, June 13, 1966.

The Kocani mill which utilizes local rice and wheat as raw material is described. The mill pulps rice and wheat straw by the soda-chlorine process in the same equipment without modification. The bleached pulp from both wheat and rice straw is of a quality useful in the manufacture of fine writing and printing paper. The efficiency of the straw pulping method depends on the quality of straw from the cutters. Therefore, dimensions and cleaning process are rigidly regulated. Rice straw has a high silica content which makes proper cooking conditions essential to reduce ash. These conditions are discussed in detail with respect to two stage digestion.

13480

Wenzl, Herman F. J. and O. V. Ingruber

INFLUENCE OF COOKING LIQUOR ON WOOD COMPONENTS IN KRAFT PULPING. Paper Trade J., 150(33):44-49, Aug. 15, 1966. 44 refs.

Investigations of the reaction kinetics of kraft delignification ar reviewed, with special emphasis on studies of the nature of the lignin, hemicellulose, and cellulose components and their decomposition products. Acid, soda, and alkali cooks are considere and the effects of different chemicals on the components are relate to commercial cooking processes. Studies have not as yet determine whether sodium sulfide, sodium hydrosulfide, or hydrogen sulfide ar involved in thiolignin reactions. In general, softwood lignins are more easily deactivated by alkali than are hardwoods, whose activation energy of delignification decreases with increasing sulfide concentration. Contrary to the general assumption that delignification in alkaline medium is a first-order reaction, Kleinert and Marraccini have shown that alkaline cooking leads to the formation of macromolecular fragment complexes and to the formation and exposure of free radicals. Delignification is divide into two reaction sequences, bulk and residual, each having differe rate constants. Christianson and Legg (TAPPI, 41(5):216, 1958) hav suggested that pulp quality and delignification rate decrease at alkali concentrations below 15 g/l of Na20. According to Regnfors and Stockman (SVENSK PAPPERSTID, 59(14):509, 1969), less than half the sulfide in the cooking liquor is consumed in the formation of thiolignins. Since lignin, hemicellulose, and cellulose are associated in wood, it is difficult to remove one component without modifying or partially removing the others. Any modification causi the retention of a large portion of hemicellulose influences the yield and properties of the pulp.

13481

Kirk, Donald G.

NITRIC ACID BLEACHING OF HARDWOOD NEUTRAL SULFITE SEMICHEMICAL PULP. Tappi, 51(4):145-151, April 1968. 26 refs. (Presented at the Fourth International Pulp Bleaching Conference jointly sponsore by the Technical Association of the Pulp and Paper Industry and the Technical Section, CPPA, held in Toronto, Ont., May 1-4, 1967.)

Use of nitric acid in place of chlorine as a first stage bleaching agent for a hardwood NSSC pulp has been studied. The purpose was the production of a high nitrogen effluent from which a fertilizer material might be recovered and marketed. Study of nitric acid- stage variables showed the necessity of keeping the temperature low and 0bleaching duration short to prevent strength loss. This required the application of high nitric acid concentrations, which made reuse of the acid an economic necessity. Modifications using alcoholic nitric acid or nitric-sulfuric acid mixtures showed some potential strength benefits, while nitrous acid appeared to cause severe degradation. Extraction stage variables within broad limits were found to have little effect on pulp quality. Ammonia was found to have little effect on pulp quality. Ammonia was successfully substituted for caustic soda to increase the nitrogen content of the effluent solids. In general, substitution of nitric acid for chlorine in the first stage of a chlorine-extraction- hypochlorite sequence can be made to produce a pulp at least equivalent to the control pulp in all respects except for a slight yellowing effect. Chemical costs are high enough to render the process economically unattractive unless a fertilizer by-product can be marketed. (Author abstract)

13484

Kleinert, Theodor N.

STABLE FREE RADICALS IN VARIOUS LIGNIN PREPARATIONS. Tappi, 50(3): 120-122, March 1967. 23 refs.

Electron spin resonance (ESR) spectra of lignin preparations isolated from spruce wood by various methods, and of a few syntheti lignin-like polymers produced from coniferyl alcohol by enzymatic dehydrogenation or mild oxidation, were recorded and compared. The specimens exhibited single-line signals (first derivatives) without noticeable fine-splitting. However, the amounts of stable free radicals present, as indicated by the signal areas, varied, probably indicating differences in the stabilizing capacity of lignins prepared by different methods. At room temperature, no significant changes in the ESR spectra were observed when the specimens were stored for extended periods of time. Apparently, the presence of stable macroradicals or free-radical centers in the specimens, as indicated by the ESR signals, is evidence that free radical reactions have taken place during the specimen preparation. (Author's abstract modified)

13505

Marton, Joseph

DETERMINATION OF LIGNIN IN SMALL PULP AND PAPER SAMPLES USING THE ACETYL BROMIDE METHOD. TAPPI, 50(7):335-337, July 1967. 10 refs. (Presented in part at the 51st Annual Meeting, Tech. Assoc. of the Pulp and Paper Industry, New York, Feb. 20- 24, 1966.)

The acetyl bromide method of determining lignin in wood was extended to determine lignin in unbleached softwood pulps. Small (5-30 mg) pulp and uncoated paper samples are dissolved in an acetyl bromide-acetic acid mixture. The absorbance of the solutions at 280 nm is related to the absorptivity of reference lignin preparations. The calculated lignin content correlates excellently with Kappa number determinations. A correction is applied to compensate for background absorption at zero Kappa number. The precision of the lignin determination method is plus or minus 2 relative percent. It has potential advantages where micro sampling is involved and the pulps are modified or the pulp lignin contains solubilizing groups. (Author's abstract modified)

13604

Hrutfiord, Bjorn F.

LIGNIN DEGRADATION PRODUCT ANALYSIS BY GAS CHROMATOGRAPHY. TAPPI, 48(1):48-54, Jan. 1965. 16 refs.

The use of gas chromatography as an analytical tool in lignin chemistry is reviewed. Lignin degradation products are classified, and general requirements for successful gas chromatography analysis of these compounds are discussed. High capacity capillary columns coated with polar and nonpolar liquid phases were used to successfully analyze phenolic compounds from several different types of degradation reactions. Polyester coatings such as diethylene glycol succinate gave excellent resolution of the phenolic compounds resulting from alkaline hydrolysis or n nitrobenzene oxidation of wood meal and lignins. Less polar liquid phases such as polyphenyl ether or apiezon L grease gave more rapid but less informative analysis. Phenolic samples from kraft liquor, pressure demethylation, and hydrogenation of lignins were also analyzed. The results presented in chromatograms indicate that gas chromatography has wide application in lignin chemistry. (Author abstract modified)

13755

Zimmermann, F. J. and D. G. Diddams

THE ZIMMERMANN PROCESS AND ITS APPLICATIONS IN THE PULP AND PAPER INDUSTRY. Tappi, 43(8):710-715, Aug. 1960. 9 refs.

The Zimmermann process is a patented wet-air oxidation system (U. S. Pat. 2,665,249) which has applications for both paper- mill waste disposal and the recovery of chemicals. Wet oxidation of a variety of spent pulping liquors has been carried out in stainless steel reactors at temperatures from 200 to 300 C and 800 to 3000 psi. The oxidation of combustibles has been as high as 95% complete. The process is a continuous operation under pressure which oxidizes combustible matter with air while both are dissolved or suspended in water. The combustion is achieved as well in water at elevated temperature and pressure as by evaporating the water and incinerating the dried residue. The products in either case are steam, nitrogen, carbon dioxide, and ash. In wet combustion the reaction occurs, and the energy is liberated in the water phase with no barrier to the transfer. The energy contained in the oxidation effluent vapor, gas, and liquid phase can be utilized in a number of ways. Using it as steam and electricity is illustrated. Oxidation data on pulping wastes suggest that stream pollution can be reduced over 90%. Power and chemical recovery can be designed to fit the specific requirements of kraft, sulfite, and semichemical pulping processes.

13768

Holder, D. A., A. B. Mindler, and D. F. Manchester

FURTHER EVOLUTION OF AN ION EXCHANGE RECOVERY PROCESS FOR SULPHITE PULPING. Pulp Paper Mag. Can., 66(2):T 55-T 64, Feb. 1965. 15 refs. (Presented at the First International Sulphite Pulping Conference jointly sponsored by the Tech. Sect., Canadian Pulp and Paper Assoc., and the Tech. Assoc. of the Pulp and Paper Industry, Chicago, June 16-18, 1964.)

Extensive pilot-plant investigation showed ion exchange to be a simple way of returning sodium directly from spent liquor to the pulping cycle without involvement in evaporation and burning. An engineering-research-operations team analyzed the technical and economic prospects of the Abiperm process of converting spent lignosulfonate into lignosulfonic acid at a specific location, an acid sulfite mill of 100 tons capacity. The process appears to be technically reliable and not subject to erratic performance. Like all processes, its economic prospects are geared to mill capacity and the slight savings indicated at the 100 ton level improve steadily as tonnage increases. Pollution control was not part of the study. (Author abstract modified)

14576

Kloss, Theodore E.

TWO STAGE PULPING PROCESS INCLUDING IMPREGNATING CHIPS WITH AMMONIA, THEN LIBERATING THE AMMONIA AND PULPING WITH MAGNESIUM COMPOUND. (Allied Chemical Corp.) U. S. Pat. 3,350,258. 2p., Oct. 31, 1967. 3 refs. (Appl. Dec. 12, 1963, 6 claims.)

A process relating to the digestion of wood chips or other ligno-cellulose materials to produce free fibers for pulp is proposed. The process involves digestion in an aqueous solution of an ammonium compound, adding a magnesium compound to the solution before the ammonium ligno-sulfonate formation, recovering ammonia from the solution, and continuing the digestion with the magnesium compound solution. Ammonia compounds are known to be effective for cooking liquor for digestion of cellulose materials, but they are economical only if substantial amounts of ammonia can be recovered. This invention provides that recovery in a form whereby the ammonia can be reused for the defibering process.

14579

Pearl, Irwin A. and Donald L. Beyer

THE ETHER-INSOLUBLE, WATER-SOLUBLE COMPONENTS OF SEVERAL SPENT SULFITE LIQUORS. TAPPI, 47(12):779-782, Dec. 1964. 7 refs.

Commercially concentrated sprucewood spent sulfite liquor, hardwood sodium bisulfite spent liquor, and soft-wood sodium bisulfite spent liquor were each extracted with ether and fractionalized into 'neutrals,' 'weak acids,' and 'strong acids' by means of ion-exchange resins. Chromotography, acid and alkaline hydrolysis, and alkaline nitrobenzene oxidation were exployed to study the fractions obtained from this arbitrary fractionation. Inherent differences in the chemical composition of the analogous fractions were found. Though 'strong acids' of the spruce liquor contained no reducing sugar after acid hydrolysis, approximately one-fourth of the 'weak acids' fraction of the spruce liquor comprised carbohydrate components in combination. The aldehyde to ketone acid yield of 7:4:6 of the spruce spent liquor 'weak acids' indicated a preponderance of material not related to lignin, but the high ratio of aldehydes to ketones to acids in the hardwood bisulfite 'weak acids' gave unexpectedly high yields of aldehydes. Since the combined vanillin yields of all three fractions of the softwood sodium bisulfite spent liquor indicate that softwood sodium bisulfite lignosulfonates are more amenable to vanillin production than those of spruce spent sulfite liquor, sodium bisulfite pulping of wood may be the preferred process for producing lignosulfonates for use in commercial vanillin manufacture.

14848

Nelson, P. F.

BY-PRODUCTS FROM WOOD PULPING. Proc. Roy. Australian Chem. Inst., 34(2):35-44, Feb. 1967. 4 refs.

The chemical characteristics of the 4 main constituents of wood - cellulose, hemicellulose (non-cellulosic polysaccharides), lignin, and extractives (materials which can be removed from wood with neutral solvents) - are described. Pulping, the separation of the wood fibers for paper-making, can be achieved by mechanical, chemical, or semichemical processes; chemical pulping removes the greatest amount of material from the wood and therefore has the highest by-product potential. Pulping under acidic conditions is usually carried out with solutions of sulfur dioxide combined wholly or partly as the bisulfites or cations, and is usually called sulfite or bisulfite pulping. The solubilization of lignin during sulfite pulping has led to the production of a series of lignosulfonates, used in adhesives, tanning, as dispersants and cement additives, and in oil-well drilling muds; they also provide a potential source of phenolic chemicals, the best known of which is vanillin. Sugars obtained in the acidic pulping process from polysaccharides are used commercially as chemical raw materials; some are fermented to produce alcohol and yeast. Alkaline pulping is normally carried out with sodium hydroxide (soda pulping) or a mixture of sodium hydroxide and sodium sulfide (kraft or sulfate pulping). The technical aspects of kraft pulping have acted to inhibit the development of economically feasible by-products. Degraded lignin products have some use in laminating resins, battery plates, and as rubber additives, but, in general, kraft lignin and alkaline-degraded polysaccharides have found few commercial applications. Turpentine and tall oil are the two most valuable by-products recovered from extractives during alkaline pulping of pine woods. The chemical reactions involved in the production of pulping by-products are fully described, and some of the factors affecting the development of by-products from chemical pulping are discussed.

16383

Klufas, A. J.

A REVIEW OF CERTAIN ASPECTS OF PRACTICAL GROUNDING TECHNIQUES. Can. Pulp Paper Assn., Tech. Sec., Tech. Paper T358; T358-T361, 1968. 9 refs. (Presented at the 54th Annual Meeting of the Technical Section, Canadian Pulp and Paper Association, Montreal, Quebec, Jan. 23-26, 1968.)

According to the Canadian Electrical Code, grounding in industrial power distribution systems should provide a safe and permanent path for 60-cps faults, lightning surges, and static charges. Four aspects of grounding are examined with respect to design and operating factors that will ensure personnel safety in the pulp and paper industry. These aspects are equipment grounding, static and lightning protection grounding, connection to earth, and testing. It is emphasized that grounding conductors should be large enough to carry maximal ground current for a reasonable time without burning off and that the impedance of the return path for ground fault currents be as low as possible. A metallic circuit enclosure containing circuit conductors can carry a major portion of the return fault current, but additional current capacity should be provided for this current by adding conductors inside the enclosure. Portable equipment should be grounded through a separate ground wire in the connecting supply cable, equal in current capacity to the largest line conductor. To obtain continuous and reliable service from ground connections, good mechanical construction must be supplemented by adequate inspection. All connections above ground surface must be inspected at least once a year. Measurement of the resistance of a ground connection is the only safe way to determine whether a ground is satisfactory. The resistance of a driven electrode should not exceed 25 ohms: lower resistances are often essential.

16386

Allan, R. S., C. W. Skeet, and O. L. Forgacs

REFINER GROUNDWOOD FROM DECIDUOUS SPECIES. Can. Pulp Paper Assn., Tech. Sec., Tech. Paper T351: T351-T357, 1968. 7 refs. (Presented at the Sixth International Mechanical Pulping Conference, Atlanta, Ga., May 14-17, 1968.)

A pilot plant investigation of the possibilities of mechanically pulping certain Canadian hardwood species to yield 90% and more is described. The experiments were limited to direct chip refining and to refining after mild pretreatment in an 'Impressafiner.' The properties of news groundwood from spruce were used as a target of pulp quality. Of trembling aspen, white and yellow birch, and red and sugar maple, only aspen could be pulped to reasonable strengths and freeness by direct reduction alone. Impregnation with sodium hydroxide resulted in major increases in pulp strength for all species but also major losses in brightness. For aspen and white birch, brightness in the 54-58 point range was obtained through addition of sodium sulfite to the impregnation liquor. Yellow birch and the maples had brightness about 10-15% below this level, and would require extensive bleaching to be acceptable for newsprint. Maple chips did not meet the target strength values. For these species, extended soaking times in the reagent and elevated temperatures are required in the pretreatment. The specific refining energy required to create a given specific surface correlated strongly with green wood properties such as tensile strength perpendicular to the grain. The higher these strength properties, the more drastic is the chemical treatment required to produce strong semi-mechanical pulps. (Author conclusions modified)

16828

Thomas, J. F., K. H. Jones, and D. L. Brink

A MECHANISM TO EXPLAIN THE PRODUCTION OF MALODOROUS PRODUCTS IN KRAFT RECOVERY FURNACES. Tappi, 52(10):1873-1875, Oct. 1969. 9 refs.

Some fundamentals of combustion which may offer an explanation for the origin of malodorous sulfur pollutants which originate in kraft recovery furnaces and which may indicate a method to control these malodors are reviewed. The combustion can be characterized by initial endothermic reactions, which degrade the organic part of the black liquor into smaller and smaller fragments, and by the competing exothermic reactions of oxidation and recombination. The recombination reactions are responsible for the formation of the malodorous compounds. It is suggested that by separating the oxidation reactions from the endothermic and recombination reactions, a furnace effluent could be produced which would be completely odor free. (Author's Abstract)

18214

Hatton, J. V.

DELIGNIFICATION OF KRAFT PULP IN THE FIRST BLEACHING STAGE USING CHLORINE DIOXIDE AND CHLORINE. Pulp Paper Mag. Can. (Quebec), 67(4):T181-T190, T204, April 1967. 25 refs.

The effect of progressive substitution of C1O2 for C1 on the efficiency of delignification using the new sequential first stage treatment developed by Hooker Chemical Corporation Dsubc has been studied at 20 C in the sequence DsubcEH. This process produces pulps of superior brightness and viscosity to those resulting from mixtures of chlorine dioxide and chlorine in the chlorination stage D/C for equivalent ratios of chlorine dioxide to chlorine. With the experimental conditions used in this investigation, superior delignification, as measured by permanganate number is afforded by sequential addition when the ratio of chlorine dioxide to chlorine exceeds 3:9 (based on oxidizing equivalent). When only small amounts of chlorine dioxide are used, Dsubc and D/C delignification treatments are about equivalent. The optimum application in the DsubcEH sequence was found to be in the range Dsub(60c60) to Dsub (70c50), though extremely efficient delignification and pulps of high brightness are obtained with levels of application as high as Dsub (100c20). The optimum application in the D/CEH sequence was found to be Dsub60/Csub60. The effect of modifying the basic sequential addition treatment has been studied. Delignification is not as efficient and pulp brightnesses are lower when a wash is incorporated between the dioxide and chlorine stages. The effect of varying the level of caustic soda applied in the first extraction stage on pulp brightness and permanganate number after D/C and Dsubc treatments has been studied in some detail. The results indicate that in order to reach a given brightness or permanganate number as much as 2% (based on pulp) caustic soda can be saved by using a chlorine dioxide:chlorine ratio of 60:60 compared to 30:90. A study of the variables associated with the extraction stage has indicated possible criteria for the selection of the most economical level of application of caustic soda. These results suggest that this level is a simple function of the oxidant applied in delignification. A tentative explanation for thee observed order of delignification efficiency is proposed. (Author abstract modified)

21971

Scott, W. D. and J. L. McCarthy

THE SYSTEM SULFUR DIOXIDE-AMMONIA-WATER AT 25 DEG. C. Ind. Eng. Chem., 6(1):40-48, Feb. 1967. 29 refs.

In spite of the industrial importance of the sulfur dioxide- ammonia-water system in connection with the ammonium sulfite paper pulping process, little basic work has been done in recent years to credit claims that sulfurous acid and ammonium hydroxide do not exist and that the sulfur pentoxide ion is an important constituent. No complete analysis has been made without assuming ideal solutions. This work uses modified standard procedures to obtain infrared absorption spectra, pH measurements, and electrical conductivity measurements for solutions over the entire range of mole ratios of ammonia to sulfur dioxide. The results indicate that only the species hydrogen (+), hydroxide (-), sulfurous radical (-), sulfur trioxide (-), ammonium (+), a solvated form of sulfur dioxide, and a solvated form of ammonia exist in the solutions in significant amounts. Negligibility considerations combined with a theoretical treatment allow calibrations of species concentrations for solutions of pH less than 7.0. The treatment is rigorous and requires no assumptions about ideal solutions. (Author abstract)

32021

Southern Research Inst., Birmingham, Ala.

AN ELECTROSTATIC PRECIPITATOR SYSTEMS STUDY. (FINAL REPORT). NAPCA Contract CPA 22-69-73, 65p., Oct. 30, 1970. 26 refs. NTIS: PB 198150

A summary of the results of an electrostatic precipitator systems study was presented. A literature review was first prepared covering the major sources likely to contain articles on precipitators or related subjects. A selection was then made of articles containing significant precipitator data. Precipitator fundamentals such a corona generation, particle charging, particle collection, removal, electrical energization, systems analysis, design, mechanical components, gas flow, resistivity, measurement of performance, trouble shooting and maintenance, and electrostatic augmentation and unusual designs were reviewed. The principal use of electrostatic precipitators in the control of industrial dusts in in the areas of electric power generation, pulp and paper, rock products, iron and steel, nonferrous metals, petroleum, chemical industry, and municipal incinerators. The extent of the use of precipitators, the range of input variables, and the design factors, costs, and problems peculiar to the use of precipitators in the particular industry were determined.

33863

Miles, F. W.

URBAN NUCLEAR ENERGY CENTER STUDY: ESTIMATES OF PROCESS STEAM CONSUMPTION BY MANUFACTURING INDUSTRIES IN THE UNITED STATES FOR THE YEAR 1980. Oak Ridge National Lab., Tenn., Chemical Technology Div. and Oak Ridge National Lab., Tenn., Reactor Div., Dept. of Housing and Urban Development Contract W-7405-eng-26, 19p., Jan. 1970. 15 refs. NTIS: ORNL-HUD-2

Estimates were made of the consumption of process steam by manufacturing industries in the Unites States for the year 1980 as part of a program for evaluating the usefulness of urban nuclear energy centers. Perazich-type assumptions were made with respect to the use of steam by the selected industries, which included the food operations industry, paper manufacturing, chemicals industry, petroleum refining, rubber and miscellaneous plastic products, and their related fields. Steam consumption in 1962 was estimated by several methods from fuel consumption data in the Census of Manufacturers. The values were projected to 1980 by using energy consumption projections. The estimates of steam consumption varied from 67.6 times 10 to the 14th power Btu to 95.4 times 10 to the 14th power Btu, depending on the methods and assumptions employed. This estimated consumption of steam by manufacturing industries is approximately equal to the 92 times 10 to the 14th power Btu of electrical energy estimated to be required in 1980. Therefore, a significant amount of thermal energy from an urban nuclear energy center would be consumed by manufacturing industries if the area served by the center had a fraction of the country s steam-using industries equal to its fraction of the country s population. (Author abstract modified)

44969

Lyon, Walter A.

EVALUATION OF NEW WATER POLLUTION CONTROL TECHNOLOGY. Dept. of Commerce, Washington, D. C., Bureau of International Commerce, Environ. Control Sem. Proc., Rotterdam, Warsaw, Bucharest, 1971, p. 93-103C. 27 refs. (May 25-June 4.) NTIS: PB COM-72-50078; GPO

Recent improvements in water pollution control technology are mentioned, and the government s role in evaluating and reshaping technology is discussed. Different aspects of industrial waste and municipal waste treatment and pollution control are discussed. Production and service technology should be given a more important role in pollution control. Many industries are learning to recycle their wastes to minimize the use of water and to recover or reuse materials which were previously discharged in the form of pollution. An outstanding example of such a production change has been the complete revamping of the pulp and paper processes at the Hammermill Paper Company in Erie, Pennsylvania. At the cost of approximately $30,000,000 this plant changed its process to increase production of pulp by 50% and reduce by approximately 2/3 its organic and color waste loads. As a result of this change, the Hammermill Paper Company will be sending its reduced water load to the City of Erie Sewage Treatment Plant for treatment where the municipal wastes will provide the nutrients necessary for treatment, and the treatment process provides for a very high degree of treatment, prior to discharge to Lake Erie. As pollution control programs expand and affect an increasing number of industries, it is likely that similar responses will be seen in industrial production and service technology in industrialized countries. (Author conclusions modified)

G. EFFECTS-HUMAN HEALTH

00996

I.O. Skalpe

LONG-TERM EFFECTS OF SULPHUR DIOXIDE EXPOSURE IN PULP MILLS. Brit. J. Ind. Med., Vol. 21:69-73, 1964.

This work is concerned with the problem of the chronic toxicity of sulphur dioxide in pulp mills. Fifty-four workers at four different pulp mills working in the acid towers and digester plants have been investigated with special regard to symptoms and signs of respiratory disease. Vital capacity has been measured with a Kifa apparatus and maximal expiratory flow with a Wright peak flow meter. The concentration of sulphur dioxide in the working atmosphere has been measured during general working conditions on a single day, and the values were found to range betwwen 2 and 36 parts per million. The control group consisted of 56 paper industry workers from the same district with similar working conditions but working in an atmosphere free from objectionable gases. No significant difference in age or smoking habits was found between the groups. A significantly higher frequency of cough, expectoration, and dyspnoea on exertion was found in the exposed group, the difference being greatest in age groups under 50 years. The average maximal expiratory flow rate was significantly lower (P equals 0.05) in the exposed group, than in those not exposed for men under 50 years. Over this age there was no significant difference between the two groups. Vital capacity values showed no significant difference between the groups. (Author abstract)

01874

D.F. Adams F.A. Young

KRAFT ODOR DETECTION AND OBJECTIONABILITY THRESHOLDS. Preprint 1965.

This study attempts to relate such environmental variables as community size, community location with respect to pollutant sources such as pulp mills and other odorous industries, together with the individual condition of the subject as to whether or not he smokes and how long he has smoked, state of his health, and whether or not women participants are menstruating at the time of serving as a subject. In addition to these environmental variables demographic variables such as age of population and distribution of males and females are related within various age groups to olfactory thresholds.

02170

B. G. Ferris, Jr. and D. O. Anderson.

THE PREVALENCE OF CHRONIC RESPIRATORY DISEASE IN A NEW HAMPSHIRE TOWN. AM. REV. RESPIRAT. DISEASES 86, 165-77, AUG. 1962.

A prevalence survey was conducted in the winter and summer of 1961 in a northern New Hampshire town that had a large pulp and paper industry. More than 95 per cent of a probability sample of the population stratified by age was selected and interviewed by means of a standard respiratory questionnaire in conjunction with two tests of respiratory function. In this preliminary report, emphasis has been placed upon methods. The significance of the variables of age, sex, and smoking habits has been outlined. The problems of differentiating these effects from those of atmospheric pollution have been stressed. Special emphasis is placed upon the importance of controlling the smoking variable before the effects of other variables such as atmospheric pollution can be determined. (Author summary)

03671

D. O. Anderson and A. A. Larsen

THE INCIDENCE OF ILLNESS AMONG YOUNG CHILDREN IN TWO COMMUNITIES OF DIFFERENT AIR QUALITY: A PILOT STUDY. Can. Med. Assoc. J. (Toronto) 95(18):893-904, Oct. 29, 1966.

An epidemiological study of illness, causing an absence from school of grade one pupils, was conducted from January to June 1965 at two west coast areas, in order to study the community health effects of emissions from a large kraft pulp mill. Enquiry was made by telephone or home visit for each of the 2084 absences experienced by the 752 pupils and the symptoms, duration of illness, physician attendance and hospitalization were determined in each case. A series of indices of disease incidence and duration were prepared to account for school transfers and different communicable disease attack rates. In general the results were non-conclusive: the incidence of all illness and respiratory illness in the control community of Berryville lay midway between that of the two towns, Seaview and Upper Seaview, which comprised the study community; certain conditions, notably tonsillectomy, inflamed eyes, headache, feverishness and nausea, were, however, more frequent in the polluted area. (Author summary)

03788

H. F. J. Wenzel and O. V. Ingruber

CONTROLLING PROBLEMS OF AIR AND WATER CONTAMINATION. Paper Trade J. 151, (3) 42-7, Jan. 16, 1967.

The nature of the substances causing kraft pulp mill odor problems; the manner and amounts in which they are produced; analytical methods for determining them; the tolerable limit of concentration; the threshold of perceptability; and control measures are reviewed. Hydrogen sulfide, methylmercaptan, dimethylsulfide, and to a lesser extent, dimethyldisulfide, are involved.

05076

B. G. Ferris, Jr., W. A. Burgess, and J. Worcester

PREVALENCE OF CHRONIC RESPIRATORY DISEASE IN A PULP MILL AND A PAPER MILL IN THE UNITED STATES. Brit. J. Ind. Med. (London) 24, (1) 26-37, Jan. 1967.

A sample of 147 men drawn from the workers in a pulp mill was compared with one of 124 men from a paper mill. The former included those exposed to chlorine and to sulphur dioxide. No significant differences were found in respiratory symptoms or in simple test of ventilatory function in the two samples, but men working in chlorine had a somewhat poorer respiratory function and more shortness of breath than those working in sulphur dioxide. The working population of both mills together had a lower prevalence of respiratory disease than that of the male population of Berlin, N.H., previously studied, suggesting that working populations may not be representative of the general population. Further, a low prevalence of disease in a working population exposed to pollutants may not indicate their 'safety' in general populations.

07339

D. A. Emanuel, F. J. Wenzel, B. R. Lawton

PNEUMONITIS DUE TO CRYPTOSTROMA CORTICALE (MAPLE-BARK DISEASE). New Engl. J. Med., 274(25):1413-1418, June 23, 1966. 5 refs.

Five cases of maple-bark disease are presented. All patients had positive agar-gel diffusion tests to extracts of Cryptostroma corticale. Spores were demonstrated in the lung biopsy in 4 of the 5 cases. The disease is a hyper- sensitivity reaction to the spores of C. corticale and does not represent a true infection since the spores do not grow at body temperature. Although 2 of the patients appeared to have extensive fibrotic disease all are clinically well, with no impairment of pulmonary function. With the removal of the patients from the spore-laden areas and changes in the manufacturing process to reduce spore concentration, the disease has been eradicated from the mill. (Authors' summary)

08828

Wenzel, Frederick J. and Dean A. Emanuel

THE EPIDEMIOLOGY OF MAPLE BARK DISEASE. Arch. Environ. Health, 14(3):385-389, March 1967. 8 refs.

A survey of the 37 workers in a paper mill which had an outbreak of maple bark disease was made. Careful clinical history, physical examination, x-ray studies, and serological tests were made. Five men had active disease. Nine men had subclinical disease, and four additional men had positive serological tests. Spore counts show a high concentration of the spores of Cryptostroma corticale especially in the winter. Positive control measures were taken, and the disease has been eliminated from the mill. (Authors' summary)

09926

Droege, Henry F.

A STUDY OF THE VARIATION OF ODOR THRESHOLD CONCENTRATIONS REPORTED IN THE LETERATURE. Preprint, California Dept. of Public Health, Berkeley, Div. of Environmental Santation, 5p., ((1967)). 6 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper 67-177.)

A major problem in any study of odor nuisance is the wide range of odor threshold concentrations reported in the literature. Six standard references have been reviewed in order to determine the reason for the wide range of odor threshold concentrations. The odor threshold for ethyl mercaptan is given as 0.073 ppm by McCord and Witheridge, whereas Stern lists a value of 0.00026 ppm. Both of these values are based on the same data. Almost all of the reported values can be traced back to a Bureau of Mines study conducted in 1930 by Katz and Talbert. In this study, six levels of odor intensity were determined, ranging from No.0 (no odor) to No. 5 (very strong). The major reason for the wide discrepancy is that some authors have used Katz and Talbert's No. 1 intensity - barely perceptible - while others have used the No. 2 intensity - faint - for the threshold level. (Author's abstract)

11828

D. R. Lamb, R. D. Shriner

PROCEEDINGS OF THE ROCKY MOUNTAIN REGIONAL CONFERENCE ON AIR POLLUTION (NOVEMBER 15-17, 1967.) Wyoming Univ., Laramie, Coll. of Commerce and Industry,110p.,1967. ((140)) refs.

The purpose of the Conference was to bring together representatives of government, industry, and research for a meaningful discussion of air pollution and its causes, effects, and cures. The following topics were discussed: Industrial Gases, Particulates, Industrial Solid Waste Management, The Internal Combustion Engine and Smog, Banquet Session, Air Pollution Effects on Meteorology and Visibility, Air Pollution Effects on Humans, Air Pollution Effects on Animals, Air Pollution Effects Plants, Air Pollution Effects on Materials, Economics of Air Pollution, Air Pollution Control by Feed Lots, Air Pollution Control by Petroleum Plants, Air Pollution Control by Power Plants, Air Pollution Control by Wood Products Plants, and Air Pollution Control by Mineral Processing Plants.

16153

Jonas, J.

OWN EXPERIENCES WITH AIR-CONTAMINATION BY SULPHUR DIOXIDE IN PAPER-MILLS AND THEIR ENVIRONMENT. (Nasc zkusenosti se zamorenim ovzdusi kyslicnikem siricitym v papirnach a jejich okoli). Text in Czech. Pracovni Lekar. (Prague), 21(7):318-323, 1969. 8 refs.

Considerable SO2 escapes into the surrounding atmosphere in one of the largest paper mills of Czechoslovakia, located in a deep valley where there is poor movement of air as the result of the production of pulp by the acid method and to the burning of high-sulfur content fuel. The SO2 level sometimes exceeds the legal threshold concentration of 0.5 mg/cu m and permissable daytime concentration of 0.15 mg/cu m. During the past six years there were 3 deaths due to SO2 poisoning and a case of acute intoxication resulting in a chronic respiratory disorder. Those living in the vicinity of the factory have a high incidence of cardiorespiratory disorders. Steps taken to improve the situation include a prohibition on the burning of sulfite waste materials and fuels with a high sulfur content. It is further recommended that head masks be restricted or alternated with mouth masks, so that workers will be more aware of increased SO2 concentration. A revision is recommended of the provisions concerning fines and penalties, which give no consideration to the area in the vicinity of the factory smokestack. However, SO2 manufacturing is not considered a dangerous situation, since the company is detecting respiratory illnesses before the damage became irreparable.

17205

Rylander, Ragnar

AIR POLLUTION IN OUR SOCIETY. A SYMPOSIUM ORGANIZED BY THE ENVIRONMENTAL HYGIENE DEPARTMENT OF THE NATIONAL INSTITUTE FOR PUBLIC HEALTH. (Luftfororeningar i vart samhalle. Symposium organiserat av omgivningshygieniska avdelningen vid Statens institut for folkhalsan). Text in Swedish. Svenska Nationalforeningen Hjart Lungsjukdomar Kvartalsskrift, 63(4):84-91, July/Oct. 1968.

Air pollution problems were discussed March 13-14, 1968 by experts in four fields: technology, animal experimentation, epidemiology, and conservation of natural resources. The task of isolating medically harmful pollutants is complicated by several unrelated factors such as meteorology, heredity, socioeconomic factors, and synergistic effects. The problem of allergens, whether natural or artificial, has been insufficiently studied. Animal experiments with pollutants seem to require higher dosages than experience would indicate, possibly because the effects experienced by humans require a combination of several such factors. A serious problem in Sweden is the matter of emissions from the paper pulp industry. Important from the medical standpoint is a better coordinated system for measuring and reporting air pollution effects on an international scale. New techniques have been developed for studying the functions of animal lungs in vivo: (1) the vibration frequency of the cilia and the secretions of the mucosa are used as indexes of the effects of various pollutants; (2) inhalation of a radioactively tagged polystyrene aerosol is followed by scintillograph measurements to determine the rate of transport away from the lungs; (3) inhalation of a bacteria aerosol, followed by evaluation of alterations in the bactericidal mechanisms of the body; and (4) renal function tests to indicate the organ distribution of various substances. Swedish epidemiologists have studied data obtained from 10,000 sets of twins in an effort to ascertain the effects of certain environmental factors in a situation where the heredity factor remains constant.

21054

Yoshida, Ryo

FUJI ASTHMA. (Fuji Zensoku). Text in Japanese. Igaku No Ayumi (Prog. Med.), 71(7):304-305, Nov. 15, 1969. 7 refs. Chiba Univ. (Japan), Dept. of Public Health.

Fuji city in the prefecture of Sizuoka, with a population of about 170,000, is an important paper manufacturing center. The prevalence of bronchial asthma among the inhibants has given rise to the term Fuji asthma. On many streets of Fuji city pollutants exceed 0.05 ppm, which is the environmental standard established by air quality legislation. Actual conditions were studied at four elementary schools in polluted areas, and also at two elementary schools in nonpolluted areas. The frequency of asthma was 1.34% in the first group and 0.7% in the latter group. Among 109 pupils with asthma, 84% experienced the onset of sickness in Fuji. When the asthmatic pupils were given an antigen liquid positive results were obtained only for 33.3% of the pupils.

23893

Tsyganovskaya, L. Kh.

HYGIENIC ASSESSMENT OF VEGETABLE DUST IN CELLULOSE CARDBOARD INDUSTRY. (Gigienicheskaya otsenka ratsitelynoy pyli tsellyulonzno-kartonnogo proizvodstva). Text in Russian. Gigiena i Sanit., vol. 6:26-31, 1970. 9 refs.

A study of the sanitary hygienic labor conditions prevailing at the time of the cutting of reeds in the cellulose-cardboard industry showed that the main noxious effect is caused by organic dust of vegetable origin. Examination of workers revealed a high incidence of lesions in the mucous membranes of the upper respiratory tracts with prevalence of subatrophic forms, disturbances of external respiration, and development of positive allergic skin reactions under the action of extracts of cardboard and particularly reed dust. The allergenic properties of reed and cardboard dust were confirmed experimentally. (Author abstract modified)

25563

Ferris, Benjamin G.

EFFECTS OF AIR POLLUTION ON SCHOOL ABSENCES AND DIFFERENCES IN LUNG FUNCTION IN FIRST AND SECOND GRADERS IN BERLIN, NEW HAMPSHIRE, JANUARY 1966 TO JUNE 1967. Am. Rev. Respirat. Disease, 102(4): 591-606, 1970. 7 refs.

Absences from the first and second grades of seven elementary schools (four parochial and three public) in Berlin, New Hampshire, were studied from January to June 1966 (716 students) and from September to June 1967 (692 students). Air pollution measurements were made during most of these periods. School absences were not significantly different between schools, despite considerable differences in levels of pollution. No cases of chronic respiratory disease, general chronic disease, or disability conditions were recorded among the students, nor was there any apperent correlation between gastrointestinal symptoms and odors from a kraft pulp mill. On the other hand, the results of pulmonary function tests indicated changes that could be due to air pollution. Children who attended (and lived near) a school in an area of relatively high sulfur dioxide and particulate concentrations tended to have lower pulmonary function. Another school was in an area with the highest average SO2 concentration but not the highest dust fall. Since children at this school did not have the lowest pulmonary function, it is suggested that particulates, as indicated by dust fall is as important as the SO2 concentrations. (Author abstract modified)

25875

Freour, P. and P. Coudray

INCIDENCE OF CHRONIC BRONCHITIS AND OF RESPIRATORY INSUFFICIENCY IN AN INDUSTRIAL RURAL POPULATION. (Prevalence des bronchites chroniques et des insuffisances respiratoires dans une population industrielle d'habitat rural). Text in French. Bull. INSERM, 25(2):165-188, 1970. 7 refs.

The incidence of chronic bronchitis and of respiratory insufficienc was studied in 1011 employees of a cellulose plant (including 874 manual workers and 86 administrative workers; 724 were smokers) situated in a rural area near Bordeau by means of a questionnaire of the British Medical Council and by medical examination for symptoms of respiratory impairment. Major symptoms were found in 7.9% and minor symptoms in 23.44% of the work force; the incidence increased with age. The incidence of major symptoms among manual workers was 8.46% and among administrative workers, 5.81%. The difference between the incidence of symptoms of workers exposed to lime dust and to humid vapors and those not so exposed was not statistically significant. Smoking did affect the incidence significantly. Of smokers, 9.11% manifested major symptoms as against 4.18% in non smokers; 38.25% smokers manifested minor symptoms as against 23.34% in non smokers. A comparison of these figures with respective values of a similar study involving an urba industrial population group (Bordeau) reveals that the incidence of broncho-respiratory symptoms among the urban group is significantly higher which can be ascribed to a difference in life style and to air pollution.

27651

Yoshida, Ryo, Ken Motomiya, Motoaki Adachi, Kozo Ito, and Seiji Kubo

HEALTH EFFECTS OF AIR POLLUTION IN PRIMARY SCHOOL CHILDREN IN B CITY, SHIZUOKA PREFECTURE, JAPAN. (Shizuoka ken B-shi ni okeru gakudokenshin kekka). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):52, 1969. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 10th, 1969.)

The city B in Shizuoka Prefecture has been developing based on the pulp and paper industry and has the average sulfur dioxide pollution concentration of about 0.08 ppm. A city-wide investigation was conducted on the asthmatic and ordinary school children; the number of asthmatic children was found to be significantly higher in the polluted area than in the non-polluted area. The average number of days of absence per person was 8.15 days and 8.08 days for polluted and non-polluted areas, respectively. A questionnaire survey and physical examinations were performed on the asthmatic children. At one school, and of 24 volunteering for examination, 19 were asthmatic, and four had allergic bronchitis. The health examination of all children in four schools in B included questions on home environment, the physical condition of the family, history, and subjective symptoms as well as physical examination including breathing tests and skin tests. Subjective symptoms included headaches, coughing, sore throat, phlegm, temperature, stomach ache, and diarrhea.

30169

Yoshida, Ryo, Takeshi Hongu, Motoaki Adachi, Kozo Ito, Masatsugu Kubo, and Shigeru Funabashi

THE RESULTS OF THE MEDICAL EXAMINATION ON THE INFANTS IN TWO AREAS IN FUJI CITY, SHIZUOKA PREFECTURE. (Shizuoka-ken Fuji-shinai 2 chiku no nyuyoji kenshin kekka). Text in Japanese. Shoni Hoken Kenkyu (J. Child Health), 29(2):108-109, Jan. 1971. (Presented at the Japanese Society of Child Health, Annual Meeting, 17th, Kurume, Japan, Oct. 16-17, 1970.)

Fuji city, which developed around the paper manufacturing industry, has many environment problems, including air pollution, water pollution, and offensive odors. In the Fujima and Iwai districts, which are located near a large paper manufacturing plant, children under seven years of age were sampled (73 infants from Fujima and 294 infants from Iwai) and tested by the Fuji city doctors committee. The investigations were carried out in June, 1969, at Fujima, and in June, 1970, at Iwai. Susceptibility to colds was 80% in Fujima, 68.5% in Iwai; 33.9% and 18.1% had asthmatic spasms within a year; and 20.2% and 11.2% had difficulty in breathing within a year. On the basis of the first examination some infants were required to take a more thorough examination in Fujima, 37 children (56.9%) and in Iwai - 71 (27.3%). The results showed a prevalence of bronchial asthma (six children in Fujima (9.2%) of those who had the first examination) and five children in Iwai (1.9%) and the first stage of bronchial asthma in 17 (26.1%) and 25 (9.6%) children. Continued observance is considered necessary for 46% of the Fujima children and 20% of the Iwai children who had the first examination.

33964

Pavanello, R. and D. Rondia

ODOUR NUISANCE AND PUBLIC HEALTH. PART 2. Water Waste Treat., 14(5):2A-3A, June 1971. 9 refs.

Offensive odors and public health are reviewed with respect to available literature, odor and fear, somatic reactions, and prevention of pollution by odoriferous products. Data on the effects of odor nuisance on human health are scarce and very subjective. Careful epidemiological studies are needed to detect long-term effects; short-term effects (vomiting, headache, or asthma) are occasionally attributed to emissions of an occasional type. Most regulations on odorous emissions concern paper pulp works. Existing technology on odor counteraction is inadequate.

34667

Little (Arthur D.), Inc., Cambridge, Mass.

EVALUATION OF COMMUNITY ODOR EXPOSURE. 31p., 1971. 58 refs. (Report resulting from discussions and based on the working papers of a symposium sponsored by the Environmental Protection Agency, April 26-29, 1971.) NTIS: PB 204989

Discussions on community odor exposure during a symposium are summarized, based on papers and reports by the participants on human reactions to odors; empirical data on odor exposure from different sources; dose-response relationships; interactions between odor sources and environmental conditions; temporal patterns; and scientific bases for performance standards. Recommendations for basic and applied research are presented. Odorous compounds were defined as those materials whose most common adverse effect is the annoyance reaction caused by the odor itself. Human reactions to odors included disease states, annoyance reactions, social and economic reactions, physiological responses, and interference with positive reactions to nonambient odors. Sensory analysis techniques to determine odors from pulp mills and diesel exhaust are discussed.

37337

Kaburagi, Sukekata, Gen-ichi Tokita, and Misa Matsumura

RELATION BETWEEN RESPIRATORY DISEASE AND AIR POLLUTION IN FUJINOMIYA DISTRICT OF SHIZUOKA PREFECTURE. (PART I). (Shizuoka-ken Fujinomiya chiku ni okeru kokyuki kei shikkan to taiki osen tono kankei ni tsuite no chosa (Dai 1 po). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan. J. Public Health), 18(10):423, 1971.

Patients which colds, acute bronchitis, asthma bronchiale, bronchitis with asthmatic attacks, chronic bronchitis, pharyngitis, and allergic rhinitis in Fujinomiya City and Shibakawa-cho were examined during March 1969 and February 1970. These two districts are contiguous to Fuji City where serious air pollution is caused by many paper manufacturing factories. During the investigation, monthly average concentration of sulfur dioxide was 0.023 - 0.037. Morbidity of acute bronchitis in these districts was lower than that of Fuji City, but bronchitis with asthmatic attacks was the same as in a non-polluted district of Fuji City. Though the effect of air pollution of Fuji City was clearly observed in Fujinomiya City a correlation between meteorological conditions, observed at the same time, and occurrence of respiratory diseases was not found.

39013

Funabashi, Shigeru, Tatsuya Hayashi, Toshiyuki Nishimuta, Nobukiyo Sakurai, Touru Takayama, Masaru Mizoguchi, Keiji Kishimoto, Yoshiko Muramatsu, Ryotara Tochigi, Yoshio Takayama, Katsumi Yamada, Akira Sato, Yukiha Ri, Amane Terajima, Junichi Ito, Misako Murata, Tsuyoshi Toba, Suzuko Uehara, Seiji Kubo, Masao Muramatsu, Koji Ito, Motoaki Adachi, Ken Motomiya, and Ryo Yoshida

RELATIONSHIP BETWEEN AIR POLLUTION AND INFANT BRONCHIAL ASTHMA, REPORT 3. AMOUNT OF SERO-IMMUNE GLOBULIN (GAMMA G, GAMMA A, GAMMA M, GAMMA E) OF ASTHMATIC CHILDREN OF POLLUTED AREA. (Taikiosen to shoni kikanshi zensoku, Sono 3. Osenchiku zensokuji no kessei meneki gurobulin (gamma G, gamma A, gamma M, gamma E) ryo). Text in Japanese. Shonika Shinryo (J. Pediat. Pract.), 35(4):460-464, April 1972. 39 refs.

Comparative studies were made of the measured sero-immune globulins (Ig) of asthmatic children of the highly polluted area and the low polluted area of Fuji city, where the main industry is paper production. The asthmatic children were among the outpatients of the pediatrics department in Chiba University, and non-allergic children were used for control. The determinations were done using the immunoplate made by H. Company for gamma G, gamma A, and Gamma M, and the indirect single radial immunodiffusion method for gamma E. There were no specific changes in amounts of gamma G of the outpatient children, but children of both polluted areas showed less gamma G than the others. The amounts of gamma A of children of both highly and low polluted areas approximated those of the control children but those of the outpatient children showed a tendency toward greater amounts when onsets of asthma occurred. The defect of gamma A was noted in a case of the low polluted area. There were no differences in the amount of gamma M among all groups. The significant difference in gamma E was noted between control children and the others, and the increase of gamma E was observed in about half of the children living in polluted areas, regardless of the degree pollution. However, the positive reactions were low with skin tests using commercial inhalation antigens. The total amount of Ig (gamma G, gamma A, and gamma M) was the smallest in asthmatic children of the highly polluted area in proportion to gamma G amounts.

39242

Deane, Margaret and John R. Goldsmith

HEALTH EFFECTS OF PULP MILL ODOR IN ANDERSON, CALIFORNIA. Preprint, Environmental Protection Agency, Washington, D. C., 22p., 1971. (Presented at the Conference on the Dose-Response Relationships Affecting Human Reactions to Odorous Compounds, Cambridge, Mass., April 26-30, 1971.)

A rural community in northern California was divided into three areas representing three levels of exposure to odors from a pulp mill. The areas were delineated by presumptive exposure based on proximity to the plant and location in relation to prevailing wind patterns and confirmed by chemical and organoleptic measurements. Systematic population samples were chosen to represent the three types of residential areas in the area and to yield approximately equal numbers of male and female respondents. Similar surveys were carried out using postal questionnaires and personal interview. Along with measurement of chronic health conditions, the frequency, recency, and attributed causes of a list of acute or transitory symptoms were determined. Background variables also included age, sex, marital status, employment, smoking habits, previous occupational exposure, and pre-existing medical conditions. Persistent cough and phlegm were several times as frequent in the area closest to the plant. No other factors to account for this difference were revealed. (Author abstract modified)

H. EFFECTS-PLANTS AND LIVESTOCK

23261

Laamanen, Arvo and Risto Lahdes

OBSERVATIONS ON THE SULPHUR CONTENT OF PINE NEEDLES FROM THE ENVIRONMENT OF POINT AND AREA SOURCES. Work-Environ.-Health, 6(1):41-43, 1969. 6 refs.

Sulfate analyses were carried out on needles of pine trees in the environment of a sulfite cellulose factory and a district heating installation using heavy fuel oil. Equiconcentration isopleths of SO4 with a valence of minus two were drawn on a map of the region. A negative correlation between the distance from the source and the sulfate concentration in the samples was noted. (Author summary modified)

24025

Koeck, G.

MILDEW ON OAK TREES AND FLUE-GAS DAMAGE. (Eichenmehlau und Rauchgasschaden). Z. Pflanzenkrankh Pflanzenschultz, vol. 45:1-2, 1935. Translated from German. Belov and Associates, Denver, Colo., 1p., June 18, 1970.

The Oak mildew (Microsphaera alni var. quercina) could not be observed at any location which had been exposed to a considerable amount of flue gases containing sulfurous acid. This was especially evident along the southwest slopes of the Haeusel Mountains which are relatively heavily exposed to the flue gases coming from a paper mill in Hinterburg. Absence of oak mildew and similarly the absence of lichen in forests which also contain oaks can be taken as an indicator for the assumption that the region concerned is strongly exposed to flue gases. If one considers the usual control of the genuine mildew fungus by means of pulverized sulfa, which tranforms under the influence of the atmosphere into sulfurous acid and thus becomes fungicidal, the above observed phenomenon becomes quite understandable.

24902

Werner, A. E.

SULPHUR COMPUNDS IN KRAFT PULP MILL EFFLUENTS. Can. Pulp Paper Ind. (Vancouver), 16(3):35-43, March 1963. 8 refs.

Kraft pulp mills convert biologically harmless sodium sulfate into a variety of sulfur-containing compounds, many of which are quite poisonous when emitted into streams and allowed to pollute the water. A historical perspective of kraft mill effluents and control techniques is presented, and a chemical analysis of the effluents is given in tabular form. The effluent is composed of several process streams, all of which ultimately derive their sulfur from black liquor. Samples of black liquor were obtained and analyzed by gas chromatography for volatile and toxic sulfur compounds. Basic black liquor chemistry, separation, and fractions are discussed. The hypothesis that detoxification of black liquor is caused by raising the oxidation state of sulfur in some of its constituent compounds is tested by exposing the organism Daphnia pulex to a range of concentrations of the toxic solution under controlled laboratory conditions. A lethal concentration, one which kills 50% of the organisms tested, is determined. It is considered to be a much more sensitive and reliable index of toxicity than previous standards are.

32561

Kudryavtseva, L. A.

SELENIUM - ITS PHYSIOLOGICAL AND THERAPEUTIC PROPERTIES. (Selen - yego fiziologicheskiye i terapevticheskiye svoystva). Veterinariya (Moscow), no. 10:60-63, Oct. 1969. Translated from Russian. Leo Kanner Assoc., Redwood City, Calif., 8p., May 1971.

The physiological and therapeutic properties of selenium are examined. With respect to its physiological properties, selenium is very closely associated with Vitamin E. Selenium readily replaced sulfur, forming selenium analogs to sulfur-containing amino acids. It plays a role in aerobic oxidation in the animal organism, decreasing its rate and by this regulating the rate of oxidation-reduction reactions. Selenoaminoacids, produced in the organism, are effective in decreasing the number of free radicals which disrupt the activity and properties of enzymes and amino acids subjected to ionizing radiation. Diseases attributed to selenium deficiency include myopathy; white muscle disease; necrosis of the liver in rats; muscular dystrophy in rodents; dietary hepatitis in large horned cattle, suckling pigs, fur-bearing animals, and chickens; exudative diathesis in chicks; paradentosis and myocarditis in swine; and resorption of the fetus. The therapeutic-preventive action of selenium is discussed. The effect of selenium in plants or fodder on the growth and development of animals is examined. In industry, the main sources of selenium are the anodic sludges from the electrolytic production of copper and from the sulfuric acid and cellulose-paper industries.

37047

Gerlach-Tharandt, R.

TESTS AND EXPERIENCE IN FORESTRY. XI. ABSORPTION AND ACCUMUATION OF SULFUROUS (SO2) AND SULFURIC (SO3) ACID IN THE NEEDLES OF OUR ORDINARY SPRUCE. (Ueber forstliche Versuche und Erfahrungen. XI. Aufnahme- und Aufspeicherungsfaehigkeit von Schwefeliger Saeure (SO2) und Schwefelsaeure (SO3, Beziehentlich H2SO4) in den Nadeln unserer gemeinen Fichte). Text in German. Tharandter Forstl. Jahrb., vol. 76:224-232, 1925.

Absorption and accumulation of sulfur trioxide in spruce needles from two forest lots exposed to the same paper producing plant emissions for more than 40 years is illustrated by analytical data from studies carried out between 1890 and 1902. The factory is located in a valley on both sides of a creek; its emissions are carried by winds. Average SO3 values (where SO3 stands for the sum of both sulfur dioxide and sulfur trioxide) on lot no. I were 0.385%, 0.444%, and 0.526% (per 100 G dry matter) in 1890, 1897, and 1902 respectively. Lot no. II showed 0.289%, 0.430%, and 0.525% SO3 values in 1892, 1896, and 1902 respectively. Average SO3 accumulation in needle samples from lot no. I was 15% from 1890 to 1897, 18.5% from

1897 through 1902 and constitutes a total of 36.2% from 1890 through 1902. Samples from Lot no. II show accumulations of 48.7%, 21.9%, and 81.3% through the 1892/1896, 1896/1902, and 1892/1902 periods, respectively. Exposure of Lot no. II to pollutant emissions started eight years later than that of lot no. I. The inhanced effects upon Lot no. II are attributed to its topographic site and to its exposure to frequent winds. The generally increasing SO3 levels in the spruce needle samples is attributed to time and technological factors (increased charcoal consumption). Maximum SO3 accumulation levels in spruce needles before falling off cannot be deduced from these data.

37352

Kaemmerer, Kurt

THE TOXICOLOGICAL SIGNIFICANCE OF SULPHITE FED TO RUMINANTS. (Zur toxicologischen Bedeutung von Sulfit beim Wiederkaeuer). Text in German. Zucker, 25(4):123-127, Feb. 1972. 30 refs.

The effects of sulfur dioxide and sulfites are discussed based on a literature survey. During the burning of coal or fuel oil, sulfur dioxide, sulfur trioxide, or sulfuric acid are emitted. Inhalation of sulfites or sulfur dioxide causes toxic reactions, such as mucous membrane infections. Ruminants tolerate considerably larger amounts of sulfites than man or monogastric animals. The pre-rumen system in ruminants acts as a dilution and buffer system. Prolonged feeding of sulfite-containing dry pulp, which usually holds about 1000 ppm SO2, causes no disorders.

38576

Kaemmerer, Kurt, Eckhard Barke, and Michael-Juergen Seidler

TOLERANCE OF SHEEP TO HIGH CONCENTRATIONS OF SULPHITE IN DRY PULP. (Vertraeglichkeit von Sulfit in hoher Konzentration auf Trockenschnitzeln bei Schafen). Text in German. Zucker, 25(4):128-134, Feb. 1972. 8 refs.

The sulfite on dry pulp is not a natural substance of dry pulp but it is a contamination product which stems from the drying process in dependence of the type of fuel used. The different types of fuels have different sulfur concentrations which lead to different sulfur dioxide concentrations on dry pulp. An average residual concentration of about 1000 mg SO2/kg dry pulp must be taken into account. Dry pulp is mostly used as fodder for ruminants in average quantities of 2.5 kg for cattle, 0.3 to 0.5 kg for sheep, and 0.3 kg for pigs. During a 90-day tolerance test with male sheep fed dry pulp containing 1% SO2, it was found that sodium disulfite was tolerable without any signs of damage to health. Weight increase was unimpaired with 500 g hay, 500 g dry pulp, and 200 g oatmeal. Introduction of dried pulp with sulfite reduced fodder uptake only in the first days of the test. Blood chemistry, transaminases, serum albumin electrophoresis, urine status, rumen function, ammonia liberation, and fatty acid formation suffered no ill effect from SO2. Dissection findings and organ weights were insignificant, apart from random findings such as renal cysts. Therefore, SO2 in factory-dried pulp can be tolerated by ruminants without any adverse effects.

39537

Wislicenus, H.

THE ASSESSMENT AND CONTROL OF SMOKE DAMAGE. (Zur Beurtheilung und Abwehr von Rauchschaeden). Text in German. Z. Angew. Chem (Weinheim), 14(28):689-716, 1901. 16 refs.

The assessment of smoke damage in a given case involves the gathering of evidence that the damage has indeed been caused by smoke, the rendering of proof of such damage, evaluation of its extent, and the estimation of damage for purposes of indexing. A methodology of smoke damage assessment on crops must include examination of the spot, consideration of other contributory factors (frost, mismanagement), laboratory tests, differentiation between acute and chronic damage, determination of the contributory share of several pollution sources, and the calculation of the actual damage accrued. Normal and abnormally high concentrations of pollutants (carbon monoxide, sulfur dioxide and trioxide, hydrogen chloride and fluoride, chlorine, carbon disulfide, cyanide, ether, gasoline vapors, hydrogen sulfide, and ammonia) in emissions from acid manufacturing plants, glass works, lime kilns, fertilizer plants, brick kilns, ceramic works, paper mills, dye works, sugar mills, the manufacture of explosives, and from railroad locomotives are tabulated, and the physiological effects of the various pollutants on plant tissues, on chlorophyll formation, and on assimilation in crops, deciduous trees, and conifers, and sampling and the analytical detection of sulfur and of fluorine in the samples are reviewed. One way of controlling smoke damage is to desulfurize coal by coking and to recover the sulfur by washing coking gas in an alkaline bath. Another way is to achieve a greater dispersion of emissions in the atmosphere by modifications in furnace and smokestack construction.

I. EFFECTS-MATERIALS

03957

H. F. J. Wenzel and O. V. Ingruber

COMBATING CORROSION IN KRSFT PULP MILL EQUIPMENT. Paper Trade J. 151, (4) 44-5, Jan. 23, 1967.

The equipment used in kraft pulp mills is made of iron or iron alloys and is exposed to aqueous solutions of inorganic and organic chemicals of different composition under various conditions of concentrate, temperature, time, and mechanical effects. Electrochemical corrosion concerns corrosion in aqueous solutions although some corrosion phenomena due to gases are also of electro-chemical nature. To test the possibility of anodic digester protection, polarization curves of steel under kraft pulping conditions were measured and analyzed. Experimental results are given.

13507

Plumley, A. L., E. C. Lewis, and R. G. Tallent

EXTERNAL CORROSION OF WATER WALL-TUBES IN KRAFT RECOVERY FURNACES. TAPPI, 49(1):72A-81A, Jan. 1966. 3 refs.

A test program designed to provide information leading to the prevention of recovery furnace tube-metal waste has been in progress for over five years. This progress report discusses the temperature limitations for the carbon steel used for heat adsorption surfaces, the corrosion resistance of various coatings under operating conditions, and results obtained from corrosion and deposit probes installed in recovery furnaces. Analytical data from laboratory tests of the chemical composition of deposits, smelts, and gases in various regions of a furnace are included. It is concluded that accelerated wastage for SA 192 metal begins at metal temperatures between 625 and 650 F. Field and laboratory studies suggest that a gas-solid reaction is the cause of wastage. In the area below the primary air ports, where corrosion is greatest, there are localized concentrations of oxygen, carbon dioxide, and sulfur- containing gases. If oxygen is sufficiently high, the hydrogen sulfide concentration is minimized. Sulfur dioxide concentrations do not appear to be affected by fluctuations in carbon or oxygen concentrations. Most of the coatings tested would prevent extensive wastage. Examination of one furnace metallized with aluminum indicates that this method is satisfactory for the area of the furnace walls above the primary air ports. The area below may require expanded metal shields packed with chrome Super 3000 refractory or pegs packed with chrome-ore refractory.

26838

Koike, Yasushi

TESTING IN THE EXPOSURE OF STEEL TO THE AIR IN THE CITY OF KUSHIRO. (Kushiro shinai ni okeru taiki bakuro shiken ni tsuite) Text in Japanese. Kushiro Kogyo Kotosenmongakko Kenkyu Hokoku (Res Repts. Kushiro Tech. Coll.), vol. 4:1-13, June 1970.

Nine samples of stainless steel and manganese steel were exposed in three different areas of Kushiro and examined for degree of atmospheric corrosion after 6, 12, and 24 months. Contrary to expectations, the greatest corrosion was observed on samples expose on the roof of a technical school located some distance from the shore on high ground. Less corrosion was measured on the roof of a paper manufacturing plant, while the least was measured on the roof of a technical college which is always under the influence of sea breezes.

33709

ALUMINUM TRUSSES FOR EXTERIOR PIPE AT NOVA SCOTIA PULP RESIST SEA AIR AND SO2. Pulp Paper Mag. Can. (Quebec), 72(10):40, 42, Oct. 1971.

Pipe trusses for a mill of a Nova Scotia pulp company were subject not only to sulfur dioxide mill gases but also to salt air causing corrosion. Aluminum was, therefore, used in place of the more readily corroded galvanized steel. The aluminum alloys used design considerations are examined. At connections between trusses and towers, phenolic laminate pads were used under bearing plates to allow the truss to move freely, compensating for thermal effects.

J. EFFECTS-ECONOMIC

01546

J.J. Hanks H.D. Kube

INDUSTRY ACTION TO COMBAT POLLUTION. Harvard Bus. Rev., 44(5):49-62, Oct. 1966.

The responsibilities of individual corporations in air pollution abatement are emphasized. Sources of pollution discussed include the paper, steel, electric power, transportation and petroleum industries. Principal equipment for removal of aerosols and particulates is described. It is concluded that although air pollution equipment increases costs in certain industries, recovery of pollutant, such as fly ash, may help to offset the costs. Government activities in air pollution programs are summarized.

01561

R. K. Johnson

AIR-POLLUTION MEASUREMENT RECORDS LOST DOLLARS. ISA (Instr. Soc. Am.) J., 13(9):40-42, Sept. 1966.

Continuous recording of particulate emission from stacks demonstrates combustion efficiency, indicates efficiency of dust collectors, and shows whether a plant meets air pollution codes. Photoelectric tubes, thermopiles, or bolometers may be used as sensing devices, and continuous monitoring may be calibrated directly in Ringelmann units. Two examples of use of the monitoring devices in stacks at pulp recovery units are given. Economic losses caused by inefficient combustion and dust collection are calculated.

14583

Ryczak, Stanley J.

BATCH PROCESSING OF TALL OIL. TAPPI, 46(2):129A-130A, Feb. 1963.

Considerations of capital costs, manpower requirements, and ease and flexibility of operations influenced the Cheasapeake Corporation's decision to adopt a batch, rather than continuous, system for crude tall-oil production. Although there is no 100% interface between the three layers obtained by separation in the cooking cycle, any lignin or spent acid carried over during the transfer of oil to the wet oil storage tank settles out in the tank and is periodically returned to the cook tank before the cleanout of the latter. Moisture in the wet oil storgae tank is present as dissolved or suspended water. To avoid discoloration or oil degradation, temperatures are not raised to drive it off. In cooking, 66 Be sulfuric acid is added through a flowrater, and live steam is used to bring the temperature up to 212-216 F. Following acid addition and heating, a Viking gear pump charges the amount of soap skimmings desired. The desired pH of the spent acid is 4.1 to 4.2 since, at this point, there is almost no residual soap in the tall oil, or excess acidity to be corrosive to tanklines. Because considerable liquor separation takes place in the soap storage tanks over the two-week filling period and liquor is returned to the evaporation process daily, soap is relatively free of black liquor and less lignin is precipitated in the cook tank. To clean the cook tank, a mixture of white liquor and water, added to the remaining lignin fraction is first heated with agitation, then pumped to a holding tank where it burns. In this process, white liquor is recovered and the lignin burns to produce steam. The plant can produce 40 tons of crude oil a day.

16174

COSTS AND ECONOMIC IMPACTS OF AIR POLLUTION CONTROL FISCAL YEARS 1970-1974. Ernst and Ernst, Washington, D. C. Contract PH 22-68-29, Task Order 2, 321p., Oct. 1969. 26 refs.

A study was conducted to estimate prospective additional costs to the private sector of the economy of controlling air pollution from both stationary and mobile sources during the years 1970-1974. The pollutants considered are particulate and sulfur oxides from stationary sources and hydrocarbons and carbon monoxide from automobiles. Estimates of control conditions prevailing prior to the passage of the Air Quality Act (1967) were taken as a base. Two types of stationary sources are considered: combustion and process. Costs are estimated for controlling three classes of combustion sources: steam-electric power generation industrial fuel combustion, commercial fuel combustion. Industries for which process emission control costs are developed are sulfate pulping, sulfuric acid manufacture, petroleum refining, asphalt batching, hydraulic cement production, steel production, ferrous casting, and nonferrous metals smelting and refining. Only automobiles are included in the mobile source class. Estimates of additional costs to the private sector are developed for nationwide control of sulfur oxides and particulates from stationary combustion sources; nationwide control or particulate from process sources in eight selected industries and of sulfur oxides from sulfuric acid and petroleum refining process; nationwide control of automobile exhaust emissions; and combined control of sulfur oxides and particulates from combustion and process sources in 85 geographical areas. Estimated costs are presented as ranges within which actual costs can be expected to fall. The economic implications of control costs for the nation are discussed. The additional costs range from $0.9 to $1.7 billion dollars for 1970 and rise to $1.0 to $1.9 billion in 1974. (Author summary modified)

16457

Julson, J. O.

ENVIRONMENTAL PROTECTION - HOW MUCH WILL IT COST YOUR MILL? Pulp Paper, 43(4):152-153, April 1969.

The cost of protecting the quality of the air against kraft mill odors, bleach plant gaseous emissions, particulates, soot, cinders, incineration of mill refuse, and water protection was discussed. Digester blow and relief gases are readily collected and can be thermally oxidized in a special furnace, lime kiln, or recovery furnace. Odor reduction was impressive and estimated capital cost was $125,000-$150,000 (1969). Turpentine should be condensed out of digester relief gases to take advantage of income generated through its sale. Black liquor oxidation is also effective in odor reduction and saves in chemical costs. Cost estimates ranged from $165,000 for a 200-ton mill to $240,000 for a 1000-ton mill. Particulate emission standards of 0.10 grains/standard cu ft of stack gas were obtained with precipitators. Capital costs for 99% efficiency ranged from $375,000 for a 200-ton mill to $1,087,000 for a 1000-ton mill. Costs for cyclone scrubbers and lime kiln scrubbers were considerably less. Capital costs for the trapping of chlorine and chlorine dioxide emissions by scrubbing in a caustic solution and returning the resulting solution back to the bleaching process ranged from $35,000 for a 200-ton mill to $155,000 for a 1000-ton mill. The installation of precipitators for soot and cinder control was estimated to cost $1.50/cu ft/min for 99% efficiency. The cost estimates of incineration of mill refuse ranged from $3400 for 50 lb/hr to $38,200 for 2000 lbs/hr. The costs of primary treatment, secondary treatment, and sludge incineration for water protection were also estimated. Capital and operating budgets will have to provide for these heavy added costs.

21241

Fogel, M. E., D. R. Johnston, R. L. Collins, D. A. LeSourd, R. W. Gerstle, and E. L. Hill

COMPREHENSIVE ECONOMIC COST STUDY OF AIR POLLUTION CONTROL COSTS FOR SELECTED INDUSTRIES AND SELECTED REGIONS. (FINAL REPORT). Research Triangle Inst., Durham, N. C., Operations Research and Economics Div., NAPCA Contract CPA 22-69-79, RTI Proj. OU-455, 414p., Feb. 1970. 360 refs. CFSTI: PB 191054

Costs are estimated for controlling emissions of particulates, sulfur oxides, hydrocarbons, and carbon monoxides from twenty-two sources within 100 metropolitan areas, through the Fiscal period 1970-1975; data defining relevant processes and air pollution control engineering characteristics required to support the analyses are presented. Sources for which control cost estimates were made are solid waste disposal, steam-electric generating plants, industrial boilers, commercial and institutional heating plants, residential heating plants, and the following industrial categories: kraft pulp, iron and steel, gray iron foundry, primary and secondary nonferrous metallurgy, sulfuric acid, phosphate fertilizer, petroleum refining, cement, lime, coal cleaning, petroleum products and storage, grain milling and handling, varnish, and rubber tires. The total investment cost includes $221 million, $1.29 billion, and $1.13 billion to control emissions from solid waste disposal, stationary combustion, and industrial process sources, respectively, while the metropolitan areas for which cost estimates are the highest include the very large, highly industrialized, more northern cities of Chicago, New York, Pittsburgh, Philadelphia, Cleveland, Detroit, and St. Louis. Assuming the 1967 emissions as a baseline, calculations are performed to determine the pollutant removal efficiencies required to bring the emissions into compliance with the standards assumed. (Author abstract modified)

23842

POLLUTION: THE COST TO INDUSTRY. Mod. MFG., vol. 10:163, Oct. 1970.

The results of a survey relating industrial groups to expenses and efforts directed toward air pollution control are discussed. The information tells what plants in various industries are spending, and indicates what they will be spending in the future. Some primary metal plants, for example, are spending as little as 1% of their manufacturing cost on pollution control while other plants in the same industry are spending 20%. Specific categories discussed include primary metal plants, metal fabrication, machinery, foods, chemicals, rubber and plastics, paper, textiles, electrical, and transportation equipment. With the data given it is possible to compare one plants efforts with those of similar plants in the industry.

26326

Japan Industrial Machine Engineering Assoc.

ACTUAL PRODUCTION OF INSTRUMENTS PREVENTING INDUSTRIAL PUBLIC NUISANCE IN 1969. (Showa 44 nendo sangyo kogai boshi sochi seisa jisseki). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(11):916-917, Nov. 1970.

Based on answers received from 98 out of 110 companies surveyed, a table is compiled of the amount invested by industry and government in 1969 in each of six categories of air pollution control equipment. The categories are dust collectors, heavy oil desulfurization equipment, exhaust gas desulfurizers, other exhaust gas purifying devices, high stacks (above 70 m), and connection instruments (?). Statistics are also presented for export sales in each category. The following types of industries are represented: food, pottery, paper-pulp, petroleum refining, chemical and petro-chemical, synthetic fiber, non-iron refineries, sulfuric acid, fertilizer, electric power, and construction.

27971

Rushton, J. D.

HOW MUCH WILL POLLUTION CONTROL COST? AND WHO WILL PAY FOR IT? Paper Trade J., 155(11):60-63, March 15, 1971. 14 refs.

In an oligopolistic industry such as the pulp and paper industry, firms tend to ignore a price increase by a competitor and respond only to a price decrease. Consequently, if a firm must spend large sums of money for pollution control equipment to meet stringent standards, it will be at a severe price/profit disadvantage in comparison with firms that do not install such equipment. Misallocations of resources will occur unless the market is corrected by applying consistent standards to all firms. After application of the standards, direct regulations, charges, or payments can be applied to allocate correctly the costs of pollution control so that the consumer or firms benefiting from the products share the costs. Once the economic method of allocating costs has been chosen, a discussion of the percentage costs borne by industry, government, and the consumer is irrelevant. In the end, all costs come back to the consumer: he either pays higher taxes, higher prices, or receives less compensation for his share of the ownership of the industry (that is, as stock, wage increases, benefits, etc. (Author conclusions modified)

30951

Japan Development Bank

TREND IN INVESTMENT ON PUBLIC NUISANCE CONTROL FACILITIES. (Kogai kankei setsubi toshi no doko). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 7(5):261-262, May 1971.

Questionnaires were sent to 893 industries with a working capital of more than $280,000 concerning their spending plans for 1970 and 1971 for installation of pollution control facilities. The 844 which replied comprised 94.5%. The total spending plan for 1970 was $479,640,000, a 58% increase from 1969 and $767,480,000 for 1971, a 60% increase. A classification breakdown shows that the steel, electric, chemical, petroleum refining, non-steel metals, and paper-pulp industries share 80% of the total spending for both 1970 and 1971. For production of anti- pollution products (improvement of products), $30,240,000 was spent in 1970 and $64,120,000 in 1971 of which the major portion was shared by automobile manufacturers and petroleum refining companies. The ratio of spending for pollution control in relation to working capital for 1971 is 6.3% as compared to 4.7% in 1970 and 4.6% in 1969. Industries with high-ratio investments for pollution control devices in 1971 are petroleumm refining (15%), paper-pulp (11%), non-steel metal (10%), steel (7%), and chemical (7%). The breakdown of spending by classification of pollution types (except for spending for improvement of products) for both 1970 and 1971 is air pollution, 65-66%; water, 27-28%; and others, 7-8%. A geographical breakdown shows that the Tokyo-Yokohama-Chiba coastal area shares 23% of the total spending for 1971; the Nagoya-Yokkaichi-Hamamatsu coastal area, 18%; and the Osaka-Kobe area, 19%. Thus, the three major industrial areas of Japan share 60% of the total industrial anti-pollution spending of Japan (58% in 1970).

31076

EXPENDITURES TO RISE IN 1972-1973. Mod. Power Eng., 65(6):62-63, June 1971.

A total of 93 plants responding to an air pollution control survey showed total expenditures of over $11 million on control equipment in the last five years. For 55 of these plants, expenditures will reach nearly $14 million in 1971, representing a $250,000/plant average. Montreal and other Quebec plants plan the most action in purchasing equipment in the 1971-1973 period. Reflecting their large steam capacity, the most active plants will be primary metal (45.5%); electrical (25%); chemical (27.8%): and good, beverages, and tobacco plants (23.5%). Plants with a steam capacity over 50,000 pph lead in making process changes and in employing consulting engineers. Other popular actions of the plant surveyed are incinerators and compactors, shredders and pulverizers. Expenses for water pollution will triple from an average of $51,00/year in 1971 to an average of $185,000/year in the 1971-1973 period. Paper and allied industries will see the most water-pollution control spending, which correlates with volume of wastes discharged/day. While the basic treatment processes of sedimentation, filtration, separation of oils and greases, and pH control will account for a sizeable proportion of the expenditures, many plants indicate an interest in more advanced techniques.

31814

Anderson, H. S., R. E. Paddock, R. O. Lyday, M. E. Fogel, E. L. Hill, and F. A. Ayer

USER S MANUAL AUTOMATED PROCEDURES FOR ESTIMATING CONTROL COSTS AND EMISSION REDUCTIONS FOR SPECIFIED AIR POLLUTION SOURCES. (FINAL REPORT). Research Triangle Inst., Research Triangle Park, N. C., Operations Research and Economics Div., APCO Contract CPA 70-60, RTI Proj. OU-534, Rept. FR-OU-534, APTD-0665, 352p., Dec. 1970. NTIS: PB 198779

A user s manual is presented enabling other researchers to use and modify the computer programs developed within this research project for estimating the costs and emissions of specified industrial air pollution sources. The output from each source program consists of emission estimates, both before and after control, as well as required control costs on a plant by plant basis. The manual describes the input requirements, operational characteristics, and output characteristics for each program. A master report generating program was also developed. This program uses as input the output from one, all, or any combination of source programs; it generates summary data in the form of a single industry or multiple industry, and sums within a range of desired geographical areas. The area may be a single or combinations of Air Quality Control Regions or states. Again, the manual describes the input requirements, operational characteristics, and output characteristics of the report generating program so that the user has maximum flexibility in the use of the present system and, in addition, has the ability to redesign the system to his specific needs. Computer programs are presented for petroleum refining, phosphate fertilizer, kraft pulping, foundry operations, sulfuric acid, primary nonferrous metallurgy, steam-electric power plants, and other industries. (Author abstract modified)

40163

THE SWEDISH FOREST INDUSTRY TO INVEST ALMOST 500,000,000 SW. CRS. IN POLLUTION CONTROL OVER A THREE-YEAR PERIOD. (Svensk skogsindustri redovisar: Miljovardsinvesteringar for 471 milj. kr under trearsperioden 1971-1973). Text in Swedish. Svensk Papperstid. (Stockholm), 75(6):201-206, March 1972.

According to a recent survey, during the 3-year period 1971-73, pulp, paper, and wood fiber mills in Sweden will invest more than 89 million dollars in measures to reduce pollution by the forest industry by installing equipment which will limit and purify the discharges from the mills into water and the atmosphere. Compared with the 3-year period of 1968-1970, when corresponding investments amounted to 34 million dollars, anti-pollution measures have indeed been stepped up substantially. Furthermore, no slackening off after 1973 is expected. On the contrary, it is estimated that the tempo will increase further, so that the total investments in pollution control during the 5-year period 1971-1975 will be 209 million dollars. The annual costs of pollution control in the pulp and paper industry are estimated to have risen to 20 million dollars in 1970, which is the equivalent of more than $1.90/ton of pulp/paper. This constitutes the running, maintenance, and capital costs of the pollution control installations. The figures concerning the forest industry s pollution control activities were compiled on the basis of a survey by the Swedish Pulp and Paper Association of pulp and paper companies. The annual costs of pollution control/produced ton are on the average somewhat higher in the Swedish forest industry than in the USA, and considerably higher than in Canada. The survey contains information from 105 firms regarding new mills, addition and alterations to existing plants, and the installation of machinery and equipment carried out mainly for the purpose of eliminating discharges from the production processes. The survey also covered the costs of research and development work in the pollution control sector. In the majority of cases, the investments are combined with an expansion and modernization of the productive machinery and only the legitimate portion of the costs, representing the pollution control measures proper, is given. The overall picture is that about 13% of 89 million dollars are spent on anti-air pollution measures, 55% on internal measures in the mill, 30% on the treatment of waste water before it reaches the receiver, and 4% on research, surveys and checks. The average annual investments in pollution control between 1971 and 1973 of 30 million dollars may be compared with the pulp and paper industry s total investment costs, which in recent years have amounted to 190 million dollars/year. This means that the efforts to improve the environment near the mills have now risen to about 15% of the total investments excluding maintenance and repairs. (Author abstract modified)

40526

Imamura, Shoji

PRESENT STATE OF ENVIRONMENTAL POLLUTION CONTROL EQUIPMENT INDUSTRIES. (Kogai boshi sochi sangyo no genjo to tomensuru kada Text in Japanese. Kankyo Sozo (Environ. Creation), 1972:59-62, Jan. 1972.

The air pollution control equipment designated by the Japan Industrial Machinery Engineering Association include categories of machines such as a dust collection system, oil desulfurization system, stack gas desulfurization system, stack gas treatment system, high stacks, and other related equipment. According to the investigation of the Association, the total production of public nuisance control systems for 1970 was $583,779,000, which was an increase of 363% over the production of the previous year. According to industrial classifications, those that showed an outstanding growth in total spending were mining (405.8% growth over 1969), government and public porgrams (308%), paper and pulp (294.5%), and food industries (254.5%). According to the categories of systems, the production installations of gas desulfurization systems grew 288.9% over 1969; but oil desulfurization system installations spent only 41.5% of the amount spent in 1969. In air pollution control systems alone, the total production was $252,726,000, and this was an increase of 114.5% over the previous year s production. In categories, the largest production figure was $119,442,000 for dust collection systems, followed by $54,393,000 for high stacks.

42690

Schwartz, Irvin

THE HIGH COST OF POLLUTION CONTROL. Chem. Week, 110(21):59-69, May 24, 1972.

Pollution control costs are holding down profits in the chemical process industries, and control costs are rising by 18.5%/yr and causing the shutdown of some chemical and petrochemical plants and refineries. However, they have led to increased production, improvements in quality, and lower operating costs at some plants. According to McGraw-Hill Inc., as of January 1972, the petroleum industry must spend $2.69 billion simply to meet existing pollution control standards; actual spending in 1971 totaled $527 million, and planned outlays for 1972 and 1975 will total, respectively, $542 million and $462 million. Results of the Council on Environmental Quality study of the economic impact of pollution control measures on the pulp and paper, aluminum, copper smelting, lead, and petroleum industries are summarized. Specific chemical industry pollution expenditures and plant closings are reported. A study by Chase Econometrics Associates, concerning the effect of pollution control measures on the U. S. economy in general, indicated that implementing existing laws for pollution control standards will require price increases of an additional 0.25%/yr during the next 10 years, or the rate of unemployment will rise as much as 0.25% during the same period. The Chase data indicate that substantial monetary and fiscal stimulus from the government will be needed to return the economy to the base line situation for GNP, price index, and fixed business investment.

43717

Rand, George H.

ECONOMICS AND OUR ENVIRONMENT. Tappi, 54(12):2000-2003, Dec. 1971. (Presented at the Technical Association of the Pulp and Paper Industry, Plastics-Paper Conference, Chicago, Ill., Sept. 12-15, 1971.)

Twenty-eight years ago a number of companies representing the major part of the paper industry founded the National Council for Stream Improvement, designed to foster research that would provide better methods of dealing with water effluents. That the paper industry has cut water usage/ton of paper in half and has waste water treatment at most mills is a practical result of the research effort. The industry has been very active in recovering cellulose fibers from waste. Last year about 20% of the paper produced in the U. S. was made from secondary fibers recovered from wastepaper; another 26% of the paper was made from secondary fibers recovered from mill waste, such as sawdust. Technologically, the industry has done well in those areas that are under its control, such as effluent treatment and odor emissions. An application of the cost- benefit concept is essential if the industry is to develop realistic solutions to environmental problems. All of the previous steps taken by the paper industry to curtail environmental pollution were economically sound and the future steps should be also.

K. STANDARDS AND CRITERIA

39224

Grace, T. M.

RECOVERY BOILER PERFORMANCE TEST STANDARD.

Technical Assoc. of the Pulp and Paper Industry, New York, Tappi Eng. Conf., 25th, Proc., Denver, Colo., 1970, p. 421-436. 1 ref. (Oct. 28, Paper 10-6.)

A new Recovery Boiler Performance Test Standard was developed to replace to obsolete Sulphate Recovery Thermal Code. The standard is based on an elemental analysis of black liquid to establish quantities of heat and material per unit time within the recovery envelope. The purpose of this standard is to establish procedures for conducting tests and preparing material and energy balances to determine capacity, thermal, and chemical performance, and related operating characteristics of sodium-base chemical recovery units used in kraft pulping. (Author abstract modified)

L. LEGAL AND ADMINISTRATIVE

03540

J. J. Sableski

THE FEDERAL AIR POLLUTION CONTROL PROGRAM AS IT RELATES TO THE KRAFT PULPING INDUSTRY. Tappi, 50(8):35A-39A, Aug 1968, 24 refs. (Presented at the 52nd Annual Meeting, Technical Association of Pulp and Paper Industry, New York City, Feb. 1967.)

The Federal air pollution control program as it relates to the kraft pulping industry, with particular emphasis on the odorous character of the industry's atmospheric emissions, is described in terms of four individual Federal activities, research, grants-in-aid, technical assistance, and abatement actions. (Author abstract)

06730

J. H. Ludwig

STATUS OF CURRENT TECHNOLOGY IN THE CONTROL OF EMISSIONS TO THE ATMOSPHERE. 90th Congress 'Air Pollution--1968, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967. p. 2274-7.

A tabulation is presented of the status of control technology for a wide range of industries. An indication is given of the presence or absence of control technology for particulates, sulfur oxides, carbon monoxide, and other pollutants. Remarks are provided regarding the difficulty or necessity of control for the various pollutants in the various industries.

06732

H. W. Gehm

STATEMENT BY H.W. GEHM FOR SENATE SUBCOMMITTEE ON AIR AND WATER POLLUTION. 90th Congress 'Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967.) pp. 2361-7, 2370-82.

Dr. Gehm is technical director of the National Council for Stream Improvement of the pulp and paperboard industries. In his statement, Dr. Gehm reviews the industry's understanding of its atmospheric emission control problems, the development of its control technology, the current state of the art and its limitations, and the industry's research and development efforts to remove these limitations. Discussed in an attachment to Dr. Gehm's statement are black liquor oxidation, absorption and oxi- dation of sulfur compounds and particulate emission control.00

06742

E. L. Wilson

STATEMENT OF E.L. WILSON FOR THE SENATE SUBCOMMITTEE ON AIR AND WATER POLLUTION. 90th Congress 'Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967. pp. 2629-45.

The use of mechanical collectors to aid in controlling air pollution is discussed in general terms. Data on the use of particulate collectors by different industries, efficiency versus particle size, and cost information are presented in an attachment. Efficiency ranges (70 to 99%) and some rule-of-thumb costs are given for mechanical collectors, electrostatic precipitators, fabric filters, and wet scrubbers.

09093

Cuffe, Stanley

COOPERATIVE INDUSTRY TRADE ASSOCIATION – PUBLIC HEALTH SERVICE ATMOSPHERIC EMISSION STUDIES. Preprint, Public Health Service Washington, D. C., National Center for Air Pollution Control, 11p., 1968. (Presented at the National Council for Stream Improvement Meeting, New York, N. Y., Feb. 20, 1968.)

A brief description is given of the various program activities in the National Center for Air Pollution Control. The Center is structured in three functional areas: Abatement and Control, Control Technology Research and Development, and Standards and Criteria. The functions and programs of each of the organizations in these areas are explained. A discussion is presented of several atmospheric emission studies conducted by the Public Health Service and a cooperative industry trade association. Also presented is a description and status report of a cooperative study of pulp and paper industry atmospheric emissions and their control.

14932

AGREEMENT BETWEEN FUJI CITY AND DAISHOWA PAPER MANUFACTURING CO. IN RELATION TO THE PREVENTION OF EXISTING PUBLIC NUISANCE. (Fujishi oyobi Daishowa seishi kabushikigaisha no kisonkogai no boshi ni kansuru kyoteisho). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(6):475-478, June 1969.

An agreement between the city of Fuji and the Daishowa Paper Mfg. Co. with respect to environment sanitation and protection of the local residents from industrial pollution is presented. The eight items of the agreement were: (I) The company is to install air pollution control facilities before the prescribed date. (II) The company will follow the occasional recommendations made by Fuji City when the need arises. (III) The company should obtain approval from the city for alteration of the conditions specified in any articles in the agreement. (IV) Fuji City is allowed to request data on the air pollution control installations from the company and is permitted to inspect the inside of the plant. (V) If any detrimental effects are felt by the local residents in spite of the existing agreement, the company should promptly take countermeasures. (VI) The company is encouraged to cooperate in beautifying the area surrounding the plant. (VII) The company is required to take prompt action if any damage to community buildings occurs. (VIII) Both Fuji City and the company are responsible for anything not mentioned above. Existing pollution control plans include decreasing SO2 emissions; alkaline mist diffusion control; noise and odor control; and waste water pollution control. The city is responsible for keeping the emission standard constant, and the company will keep alkaline emissions to 0.075 g/N cu m.

17379

Grotterod, K.

AIR AND WATER POLLUTION IN SWEDEN: THE PROBLEM, THE EFFORTS AND THE PROGRESS. Pulp Paper Mag. (Quebec), Can., 71(5):64-66, March 1970. (Presented at the 5th Paper Industry Air and Stream Improvement Conference, Toronto, Ontario, Oct. 21-23, 1969.)

Like most other developed countries, Sweden has found that its lakes and rivers are being choked by municipal sewage and industrial wastes. Determined efforts to improve conditions have resulted in significant improvements. It is forecast that within 10 years, all municipal sewage plants will be equipped to remove nutrients. In the pulp and paper industry, pollution control measures have been in the form of tight control of kraft mill operations and elimination or reduction of sulfite liquor discharge into lakes and rivers. For recovery of suspended solids, internal mill water systems have been tightened up. Further improvements have been achieved by the use of savealls, clarifiers and, when necessary, lagoons. As most of the recipient waters are slow moving or stagnant, emphasis is placed on dispersion. Many mills are required to install long pipelines with dispersion nozzles for proper mixing of effluents with the recipient water. The cost to industry of complying with new environmental legislation is estimated in excess of 200 million dollars. Of this sum, about 140 million dollars will be spent by the pulp and paper industry. The legislation covers discharge of effluent, solids or gas from land, building or installation into water courses, lakes, or other waters; use of land, building or installation in a manner which can cause pollution of water courses, lakes, or other waters; and use of land, building or installation in a manner which can cause disturbance to the surroundings by air pollution, noise vibration or other such

19062

Spaite, Paul W.

FEDERAL AIR POLLUTION PROGRAM: READY TO FINANCE MORE OUTSIDE HELP. Chem. Eng., vol. 75:170-172, Jan. 15, 1968. (Presented at the Metropolitan Engineering Council on Air Resources Meeting, New York, Oct. 23-24, 1967.)

The trend in the federal research and development program for controlling sulfur pollution is toward spending more on contracts outside the government. Research and development funds managed by the National Center for Air Pollution Control are shown in tabular form. The figures represent the federal expenditures oriented directly for sulfur oxides control. A study was conducted to determine the processes worthy of support. Three approaches were selected for the first-generation large-scale study: limestone or dolomite injection, including dry processes, and injection coupled with water scrubbers; alkalized-alumina sorption; and processes that would treat pyrite-coal mixtures derived from deep cleaning of coal to produce heat, sulfur, and sulfuric acid. The program for developing new processes is aimed at providing second-generation processes for removing sulfur dioxide from flue gases arising from the combustion of fossil fuels. Two types of contracts are being negotiated. One will be devoted to through, broad surveys of available technology in nine areas: aqueous solution, dry metal oxide sorption, direct reduction to sulfur, inorganic liquids and solids, organic liquids and solids, catalytic oxidation, and physical separation. The second contract calls for unsolicited proposals. To encourage more extensive control of such sources as primary smelters, pulp and paper mills, sulfuric acid plants, and coke plants, a series of studies on cooperative research and development are planned.

20273

Fletcher, R. H.

KITIMAT POLLUTION CONTROL BY-LAW. Pulp Paper Mag. Can. (Quebec), 71(7):78-90, April 3, 1970. (Presented at the 5th Paper Industry Air and Stream Improvement Conference, Toronto, Ontario, Oct. 21-23, 1969.)

Land use in the 16-yr-old town of Kitimat, B. C., was planned to minimize the conflicts that can exist between residential areas and industry. Prior to the advent of a pulp and paper complex with a 930 tpd Kraft mill and a 150 million fbm per year saw mill, the town's principle industry was an aluminum smelter. To preserve the quality of its environment, the town passed a waste emission by-law that requires the monitoring of selected emissions from the pulp mill and smelter. The law, to become effective in December 1970, identifies a tolerable level of pollution which is expected to be met, but no exceeded, by the two industries. The level of emission from an industry is related both to the type of equipment used and to the way in which it is operated. The levels, determined from experience recorded elsewhere and those found tolerable by local authorities in an assimilation study, are as follows: cinders from power boilers, 150 gr per 1000 cu ft; sodium compounds, 200 gr per 1000 cu ft. all particulate matter; volatile organic sulfur compounds, 0.2 lbs/ton; calcium compounds, 250 gr per 1000 cu ft all particulate matter; and volatile fluorine compounds, 2.5 lbs/ton.

28355

Szwarcsztajn, Edward

POLAND--NORWAY. Pulp Paper Int., 13(1):39, Jan. 1971.

Environmental regulations affecting the pulp and paper industry are being formulated in most countries. However, as indicated by the examples of Poland and Norway, these regulations vary greatly from country to country. In Poland, water intake for industrial use and waste disposal to a stream require special permission from water authorities. This permission determines the total load of individual pollutants as well as their concentrations the allowed quantity of water intake, and the appropriate disposal method. Maximum allowable concentrations of pollutants that can be discharged to air or water are strictly defined, and three classes of inland surface water purity have been established. In Norway, no less than six different ministries may be involved in the different aspects of pollution, and there is considerable overlapping of various laws. A 1940 law regulating the dumping of harmful materials in lakes and rivers has had few restrictive effects on water pollution. It is being replaced by a new law that also takes into account pollution of salt water and ground water. A 1961 air pollution law requires that new plants and industries obtain government permission to operate and apply the best available methods for smoke and odor reduction. The law has not yet been extended to cover emissions from older industries.

28389

Semling, Harold V., Jr.

WHAT TO EXPECT FROM EPA AND THE COURTS. Chem 26, 7(3):30-36, March 1971.

Reasons are cited as to why the pulp and paper industry can expect increased activity in the environmental area in the next few months. First, the problem has been recognized, not just by the government regulators, administrators, and scientists, but by the general public. Second, the public is putting its money, its votes, and its style of life on the line. Third, Congress has passed a wide range of legal authorities and procedures, both in terms of regulation and financial assistance, which are either in existence or under intensive development. The assessment of chemical use, state and local activity, resource recovery, the 1970 Clean Air Act, water pollution, the Refuse Act of 1889, permits, industrial waste studies and inventories, rules on tax deductions, the Council on Environmental Quality, the Environmental Protection Agency, and the national Industrial Pollution Control Council are mentioned.

30149

Shigeta, Yoshihiro

RESEARCH ON ODOR ABATEMENT AND CONTROL IN U.S.A. (II). (Amerika ni okeru akushu no kisei to taisaku II). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(4):9-20, March 1971. 12 refs.

Odor measurement in Seattle with a scentometer, actual conditions of obnoxious odor in the Columbia-Willamette Valley, Portland and its control regulations, and the control regulations of Chicago, Cleveland, and St. Louis were described. The kraft paper mill in the Puget Sound produces 325 tons/day of kraft paper with 9 digesters. The odor is a problem in the residential area about 6 km to the east of the kraft pulp mill, and its white smoke can be seen 30 km away. An electric dust collector was installed the recovery boiler was modified in 1968. By 1975, 98% of dust and more than 99% of odor will be eliminated. At present, the odor of the noncondensable gas is drawn out by fans and is burned by atomizing the oil burner at over 1000 F. The rest of the odor is eliminated by the Los Angeles formula. The Puget Sound Air Pollution Control Agency carries out wide range of air pollution control activities. A scentometer and the iodimetry method are being used for odor control. The Columbia-Willamette Air Pollution Authority consists of 5 counties and has 8 air pollution monitoring networks. One-third of the complaints it receives from the citizens were on obnoxious odors, but very few enterprises actually violate the pollution control regulations. Portland, as well as Los Angeles, is one of the few areas which made the installation of deodorizing devices compulsory. Chicago makes it a violation of the Air Pollution Control Law to emit soot, fly ash, dust, and embers within 1.6 km of the city. Cleveland s Air Pollution Control Law forbids the emission of harmful, poisonous, irritating odors, fumes or other pollutants from chimneys. In St. Louis, no one should emit obnoxious odors which are unpleasant to the people. In the industrial area or its neighboring areas, no odor of more than 20 Odir units is to be emitted, as measured with an olfactometer. When more than 30% of the residents in a residential area suffer unpleasant odors, such an odor is regarded as environmental pollution. No rendering factory can be operated without deodorizing in an approved manner.

31465

Wrist, P. E.

IMPACT OF NEW AIR POLLUTION REGULATIONS ON THE PULP AND PAPER INDUSTRY. Tappi, 54(7):1090-1093, July 1971. (Presented at the Technical Association of the Pulp and Paper Industry, Water and Air Conference, Boston, Mass., April 4-7, 1971.)

The Clean Air Act of 1970 departs from the trend of previous legislation in that it places emphasis on emission standards and emission monitoring, coupled with speedier processes of enforcement to improve air quality. Implications of this act upon the pulp and paper industry are explored. The importance of participation in standard settings is emphasized, together with the need for development of better instrumentation and an understanding of the effect of normal operating variables on the level of odor emission. The technical person can have a major influence on the economic impact which the new act will have on industry. (Author abstract)

32796

Wada, Masaru

ON ENACTMENT OF OFFENSIVE ODORS CONTROL LAW. (Akushu boshiho no sentei ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):780-787, Sept. 1971.

The statistics of complaints made against bad odors in 1969 indicate that 38.0% of the total was made against stockfarming, animal offal treatment and fishmeal plants; 36.6% against oil chemical factories and Kraft pulp mills; and 8.6% against sewage treatment plants and waste disposal incinerators. Detailed tables of statistics are included. The Odor Control Law, issued on June 1, 1970, its purpose, odor producing materials, definition of odor producing areas, and other items in the law are reviewed. Currently available deodorizing methods include the gas cleansing method, effective for water, ammonia, low molecule amines, low molecule fatty acids, acidic alkalines, hydrogen sulfide, mercaptans, sulfides and high molecule amine fats, applicable to agriculture and stockfarming, sea products manufacturing, and urban sanitation facilities. The ozone oxidation method is effective for nonsaturated organic chemicals, hydrogen sulfide, mercaptans, amines, aldehyde-sulfides and is applicable to sewage treatment plants. The direct combustion method is effective for oil refineries and oil and fat treatment factories. The catalytic oxidation method is effective for hydrocarbons and applicable to paint-varnish solution mixing, oil-fat processing, pharmaceuticals, resin manufacturing, animal cadaver incinerators, and sewage treatment plants. The adsorption method is effective for alcohols, fats, acids, benzene, mercaptans, and oil, applicable to fishmeal plants, fertilizer plants, pharmaceutical plants, propane gas filling plants, and vacuum cars. The air oxidation method is good for hydrogen sulfide and is used at oil refineries. The soil oxidation method is good for ammonia and amines, and is applicable to poultry farms. The ion exchange resin method is effective for sewage treatment plants.

32893

Hattori, Taira

OFFENSIVE ODOR CONTROL ADMINISTRATION TODAY AND TOMORROW. (Akushu kogai gyosei no genjo to tenbo). Text in Japanese. Yosui To Haisui (J. Water Waste), 13(8):957-961, Aug. 1971.

The provisions of the Offensive Odors Prevention Law in Japan, enacted June 1, 1971, and the controversies surrounding it are reviewed. The law designated criteria to control respective substances contributing to offensive odors but not the odors themselves, since unpleasant odors are generally a complex combination of two or more odorous components. The sources of the offensive odors (oil industry, paper pulp industry, stock raising) are easily specified, and the representative odor generating substances are also easily determined; control of these substances, e.g., methyl mercaptan or ammonia, effects a control of the odors. Controls of specific components rather than general odors are more effective with respect to legal factors. Evaluation of an offensive odor by a human panel is not irrefutable evidence in a law suit, but instrumental analysis of a known odor-causing substance is accepted.

34685

Dept. of Environmental Quality, Portland, Ore., Air Quality Control Div.

REPORT ON OREGON S AIR QUALITY AND PROGRAM FOR YEARS 1968 AND 1969. 91p., Dec. 1969.

The history of air pollution control in Oregon is reviewed. Recent environmental legislation is outlined, and the program of the Department of Environmental Quality is presented. During 1969, a statewide rapid survey of emissions of all major contaminants was made, using a variety of estimation techniques. Pollutants included nitrogen dioxide oxidants, nitric oxide, sulfur dioxide, and carbon monoxide. Meteorological factors were considered. The Oregon-Washington Air Quality Committee developed and published recommended standards for suspended particulate and particle fallout, and initiated development of ambient air quality standards for sulfur dioxide. Emission standards and regulations were also issued. Activities of the Department of Environmental Quality include the investigation of complaints, air quality monitoring, community surveys, special studies, and educational activities. Enforcement and control are discussed for various sources such as pulp mills, asphalt plants, rendering plants, open burning, and motor vehicles. Tax relief for pollution control facilities is discussed, as well as future program needs.

35817

Gavelin, Gunnar

AIR AND WATER POLLUTION REGULATIONS AND CONTROLS IN SWEDEN, Paper Trade J., 156(2):38-39, Jan. 10, 1972.

Air pollution abatement problems in Sweden are handled by the National Environmental Protection Board (NEPB), established in 1965. The role of the NEPB is defined in a 1969 environmental protection law which forbids any pollution that is technically and economically possible to avoid. A franchise board decides what measures must be taken, and failure to abide by its instructions results in fines or imprisonment for up to one year for persons responsible. Unless exempted by a NEPB license, all pulp and paper mills must apply to the franchise board for permission to use sewer water and emit gases to the atmosphere. NEPB recommendations lack the legal status of a franchise board permission, but are usually just as stringent. Many mills prefer to apply to the NEPB because a constructive dialogue with technical experts is possible. Enforcement of the stipulations in franchises and licenses are entrusted to local authorities, who require monthly reports from every mill. Pollution abatement investment costs of older industries are subsidized by the NEPB. New industries are expected to make atatement an integral part of their operation and receive no subsidies. Research in air and water pollution is a joint effort of industry and government, both sponsors of the Forest Industry Research Foundation for Air and Water Protection.

36900

Agency of Scientific Technology (Japan)

THE TREND OF SCIENTIFIC TECHNOLOGICAL DEVELOPMENT AGAINST ENVIRONMENTAL POLLUTION PROBLEMS. (Kankyo osen mondai ni taisuru kagaku jijutsu katsudo no genjo). Text in Japanese. In: White Paper on Scientific Technology. p. 30-46, 1970.

The total spending for 1970 toward research projects for environmental pollution control, excluding labor and administration, was approximately $4,480,000. Of the total, 37.8% was spent for air pollution, 27.8% was for water pollution, 29.1% for others, 2.5% for bad odor, and 2.8% for noise and vibration. Private industries with more than $1.6 million capitals (287 industries) spent approximately $36,800,000 in 1969. A breakdown of classifications shows that 15.9% was spent by 14 paper and pulp industries, 9.8% was spent by 12 electric and gas industries, 7.7% was spent by 25 transportation machinery industries, and 6.8% was spent by 23 machine industries. The 1970 goals for the control of sulfur oxides are: desulfurization of stack gas by activated manganese and activated carbon, both with more than 90% efficiency, and the direct desulfurization of crude oil by the suspended catalyst method with 75% desulfurization or less than 1% sulfur content. The goals for automotive exhaust gas control methods are the development of exhaust mainfold reactor, catalytic converter, and exhaust gas recirculation method. They are aimed at the 1975 emission standards of 7 g/km carbon monoxide, 0.3 g/km hydrocarbon, 0.6 g/km nitrogen oxides, and 0.6 g/km particulates.

40544

Hendriks, Robert V.

NEW DEVELOPMENTS IN AIR POLLUTION LEGISLATION AFFECTING THE PAPER- CONVERTING INDUSTRIES. Preprint, Technical Assoc. of the Pulp an Paper Industry, New York, 8p., 1971. (Presented at the Technical Association of the Pulp and Paper Industry Plastics Paper Conference, Chicago, Ill., Sept. 15, 1971.)

Since the start of federal government involvement in air pollution control in 1955 when Congress passed legislation authorizing a federal program of research and technical assistance, there has been a fairly steady trend of increased government involvement in pollution control programs, culminating with the Clean Air Act of 1970. One of the new features of the act was the establishment of new source performance standards. The federal government has been given the responsibility of categorizing important stationary sources of air pollution and setting national emission standards that all proposed new or modified facilities will have to meet. The government is also authorized to set national air quality standards for pollutants having any known adverse effects. Standards have been set for sulfur dioxide, particulates, carbon monoxide, hydrocarbons, nitrogen dioxide, and photochemical oxidants. Standards are being formulated for asbestos, mercury, and beryllium. The air quality standard which most immediately affects the paper-converting industry is the limit on hydrocarbons at 160 micrograms/cu m. A government-industry cooperative study investigated a number of possible control techniques. The processes with the greatest air pollution potential are lithography and metal decorating. The existing technology of small fixed-bed sorbent and catalytic combustion package devices for hydrocarbon pollution control from small emission source industries was also evaluated. Possibilities for meeting new emissions standards include changing the coating and printing make-up to solvent-free or low-solvent formulation, changing process operations, and using various types of control equipment such as incinerators, adsorbers, and scrubbers.

41093

FEDERAL GUIDELINES ARE AIMED AT HELPING FIRMS MEET RULES. Can. Pulp Paper Ind., (Vancouver), 25(5):27, 29, May 1972.

Environment Canada is bringing out a set of guidelines that will assist pulp and paper companies and regulatory agencies with the implementation of the federal government s new effluent regulations. The Environmental Protection Service of the department is taking on the job of carrying promising new pollution control technology beyond the research stage to practical demonstration. The intent is to encourage recovery at the source by treating to practicable levels. The guidelines will go into somewhat more detail than was possible in the regulations themselves with respect to how the standards should be calculated for each mill and how they are intended to be implemented. One aspect of the regulations is that they specify limits not just for the plant as a whole but for each step or processing unit within it.

M. SOCIAL ASPECTS

00376

N. Z. Medalia

AIR POLLUTION AS A SOCIO-ENVIRONMENTAL HEALTH PROBLEM: A SURVEY REPORT. J. Health and Human Behavior 5, 154-65, 1964.

An attempt has been made to explore the behavioral variables of situation-defining in relation to a specific environmental stress, sulfate odors associated with kraft pulp mill operation. The results of this study are presented because of the methodological and conceptual implications relative to social science research on environmental health problems. The following topics are discussed: Awareness of and concern with air pollution; community satisfaction and concern with air pollution; analysis of action potential with reference to environmental stress; ecological and social status variables in air pollution awareness and concern; and air pollution as an ecosystem variable.

00844

N.Z. Medalia

COMMUNITY PERCEPTION OF AIR QUALITY: AN OPINION SURVEY IN CLARKSTON, WASHINGTON. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. June 1965. 106 pp. GPO: 820-365-9, HEW: 999-AP-10

In a community with a population of 7,000 and located approximately 4 miles downwind from a pulp mill, a public opinion survey was taken to analyze the environmental stress of air pollution on a sample of household heads and spouses, along two principal attitudinal dimensions: awareness and concern. Of those interviewed, 91% perceived air pollution in the community as a malodor problem; 74% perceived it as a problem of visibility; and 62% as a problem of nose-throat irritation. A Guttman-type scale showed high concern with air pollution among 48% of the sample; low to moderate concern among 31%; and minimal concern among 21%. Although exposure ot odorous pollutants in ambient air appeared roughly equal for all members of the sample, their concern with air pollution was found to vary directly with social status and attitude characteristics such as civic pride, desire to ameliorate the situation, length of residence in the community, and occupational prestige of the household head. (Author abstract)

07965

Julson, J. O.

POLLUTION -- A COMMENT ON ITS POLITICS AND PREVENTION. TAPPI, 50(4):36A-38A, April 1967. 6 refs. (Presented at the 52nd Annual Meeting, Technical Assoc. of the Pulp and Paper Industry, New York, N.Y., Feb. 19-23, 1967.)

The broad aspect of pollution abatement, applicable in the broad sense to air and water alike is discussed. Public pressures have made it possible for politics to enter into and play a very important role in new pollution control regulations. Sensationalism could replace rationality in development of pollution control legislation. Managements in the pulp and paper industry are charged with having done nothing substantial in the way of alleviating pollution. Many people are not well enough acquainted with past accomplishments of the pulp and paper industry. Molders of public opinion, educators, legislators, governmental people, and regulatory agencies need to be informed on the problem, its solution, and cost. Managements need to accept their responsibilities and set policies in line with regulations adopted. Out industry will grow, rather than shrink. We must guide ourselves accordingly. AAM

08698

Nelson, Bryce

AIR POLLUTION: THE 'FEDS' MOVE TO ABATE IDAHO PULP MILL STENCH. Science, 157(3792):1018-1021, Sept. 1, 1967.

A major inversion occurred in 1959; one resident recalls it as 'the black night.' After such incidents, more citizens protested, and the mayor of Lewiston created a committee on air pollution. In Nov. 1960, the mayor of Clarkston wrote to the chief of the Division of Air Pollution of PHS to request help in abating an interstate air-pollution problem said to be principally caused by the PFI mill. In response to this request, the PHS initiated several meetings with local and state authorities and began a study of air pollution in 1961-62. The PHS study indicated that Lewiston and Clarkston had a common air mass and that either city could pollute the air of the other. The PHS report stated that 50 percent of the physicians in Lewiston and Clarkston had been interviewed and that a large majority of the physicians stated that they concurred in their patients' belief that certain of their disease conditions were related to air pollution and that several noted improvement in patients with respiratory conditions when the patients moved from the area of high pollution or used air conditioning. Included in the PHS-study was an opinion survey conducted in 1962 about community perception of air quality in Clarkston. Nearly 80 percent of those interviewed said that their city was affected by air pollution, and almost two-thirds stated they were bothered by it to some degree. More than 90 percent who recognized air pollution as a problem first mentioned the pulp mill as being among the sources of such pollution. In March of this year, a conference on the areas air pollution was held in Clarkston. The conference provided many area citizens with an unparalleled opportunity to voice their frustration about the condition of their local atmosphere.

09199

Friberg, Lars, Erland Jonsson and Rune Cederlof

STUDIES OF HYGIENIC NUISANCES OF WASTE GASES FROM SULFATE PULP MILL (PARTS I: AN INTERVIEW INVESTIGATION. AND PART II: ODOR THRESHOLD DETERMINATIONS FOR WASTE GASES.)Translated from Swedish Norsk Hygienisk Tidskr., 41(3-4):41-62, 1960. 1 ref.

The results of an interview investigation of approximately 400 persons chosen at random and living near (maximum of 2 miles distance) a sulfate pulp mill in Sweden are reported. The investigation0s principal purpose was to study the annoyance of air pollution from the mill. Sulfate odor annoyed 36 percent of those interviewed, and of those annoyed a third described their complaint as severe. In spite of this, only 5 percent considered it undesirable to have the mill move to the region. Comparisons between different parts of the investigated area showed a connection between the residence of those interviewed in relation to the mill and the relative proportion of persons annoyed. The investigation showed that women are annoyed more than men and the young more than the old. A definite relationship was found between annoyance from odor and poor state of well-being. Persons who were annoyed by 0sulfate odor0 complained about the odor from a sulfite pulp mill in the investigated area to a greater extent than persons who were not annoyed by sulfate odor. Test subjects, chosen by lot from the populace living around the mill, consisted of 20 men and 20 women. Half were under 50 years and half were over 50 years.

13980

Nishiyama, Keitaro, Mitsuyoshi Nagayasu, Takeo Azuma, and Masaichi Ishizawa

STUDIES OF THE PREVENTION OF PUBLIC NUISANCE BY THE EXHAUST GASES FROM THE KRAFT PULP MILL. PART 3. INFLUENCES OF ODOR ON N-AREA INHABITANTS. (KP seishi kojo haigasu no kogai boshi ni kansuru kenkyu dai 3 ho kojo shuhen no shuki ni taisuru jumin no hanno ni tsuite). Text in Japanese. Shikoku Igaku Zasshi, (Shikoku Acta Medica), vol. 24:43-52, 1968.

A survey of bad odor was undertaken in the area within 6 km of a kraft pulp mill labeled the N mill. Of 749 inhabitants, 87.8% recognized the bad odor and most referred to the mill as its source. A number of people found that the odor existed throughout the year. This is due to the unstableness of the wind direction in the area. Approximately 29% of the inhabitants were forced to close the windows and doors and 52% of that group said they failed to get rid of the odor. The chief complaints of the inhabitants were unpleasantness, mental oppression, meals not enjoyed, disturbed reading and work, and respiratory disorders. Comparative studies of locations in different directions and distances from the mill did not show clear differences. (Author abstract modified)

15760

Lindvall, Thomas

THE NUISANCE EFFECTS OF AIR POLLUTANTS. (Luftfoeroreningars olaegenhetseffekter). Text in Swedish. Nord. Hyg. Tidskr. (Stockholm), no. 3:99-115, March 1969. 11 refs.

Annoyance reactions from odorous and particulate air pollutants were regarded as medico-hygienic problems in Sweden. Legislation in Sweden permits intervention based solely upon subjective annoyance reaction to some extent. Nuisances from industrial plants are usually caused by odors and particulate matter. Complaints were reported in 78% of urban and 27% of rural communities. The medico-hygienic evaluation of nuisance from air pollution includes studies of the dose-response relationship between the pollutant in the ambient air and the extent and strength of the annoyance reaction. The description of the dose is often complicated by the fact that many odorous substances are hard to detect while they still have odor. Therefore, the concentration in the ambient air is often based upon analysis at the source combined with meteorological spreading calculations. From a statistical point of view, there is often a satisfying correlation between predicted and actual concentrations in the ambient air. The organoleptic principle of analysis of odorous emission was used more frequently during the last few years. Odor threshold determinations were successfully used in testing odor abatement equipment and in dose description around pulp mills. The frequency is calculated by which a certain concentration is exceeded at different distances from the source. The description of the dose was satisfactorily worked out by the use of standardized, sociological inquiries with special attention to certain effects of interaction, such as disquising of or differences in attitude. Response studies were undertaken in Sweden around pulp mills and oil refineries. (Author summary modified)

23344

Goldman, Marshall I.

THE CONVERGENCE OF ENVIRONMENTAL DISRUPTION. Science, 170(3953):37-42, Oct. 2, 1970. 12 refs. (Presented at the International Social Science Council's Standing Committee on Environmental Disruption, International Symposium on Environmental Disruption in the Modern World, Tokyo, March 1970.)

An attempt is made to ascertain why it is that pollution exists in a state-owned, centrally planned economy like that of the Soviet Union. Perhaps the best known example of the misuse of water resources in the USSR has been what happened to Lake Baikal, in which there were over 1200 species of living organisms, including freshwater seals and 700 other organisms that were found in few or no other places in the world. In 1966, first one then another paper and pulp mill appeared on Lake Baikal's shores, and a few months after their effluent had been discharged into the lake, animal and plant life had decreased by one-third to one-half in the zone where the sewage was being discharged. Of all the factories that emit harmful wastes through their stacks, only 14% were reported in 1968 to have fully equipped air-cleaning devices. Leningrad has 40% fewer clear days than the nearby town of Pavlovsk. Excessive construction has loosened the soil and accelerated the process of erosion, while much of the Black Sea area has been simply hauled away by contractors. As in the United States, the Russians have not been able to create clear lines of authority and responsibility for enforcing pollution-control regulations. They too have been unable to adjust their accounting system so that each enterprise pays not only its direct costs of production for labor, raw materials, and equipment, but also its social costs of production arising from such by-products as dirty air and water. State officials in the Soviet Union are judged almost entirely by how much they are able to increase their region's economic growth, and as industrialization has come relatively recently to the USSR, the Russians tend to emphasize an increase in production. Until July 1967, all raw materials in the ground were treated by the Russians as free goods, while economic growth has been even more unbalanced than in the U. S. However, the Russians have the power to prevent the production of various products, and they have not permitted as much emphasis on consumer goods. While not all Russian laws are observed, they do have an effective law enforcement system which they have periodically brought to bear in the past.

40951

PUBLIC ACCEPTS POLLUTION AS MAJOR PROBLEM AREA. Can. Pulp Paper Ind. (Vancouver), 25(5):30-31, May 1972.

Since Pollution Probe was founded four years ago, the organization has grown to incorporate 50 chapters across Canada, mostly in Ontario. The aim of the group is to reduce the discharge of effluent to a level society agrees is not harmful to competing users of the air and water resources. A recent conflict has been over commercial logging in Canada s provincial and national parks. Donald A. Chant, the chairman of the board of advisors to Pollution Probe and one of the group s founding members, thinks that the pulp and paper industry does not do a very good public relations job, and that the industry has been slow in developing economic ways of recycling its products.

N. GENERAL

08409

Wenzl, Herman F. J. and Otto V. Ingruber

RECOVERY OF BY-PRODUCTS OF THE KRAFT PULPING PROCESS. Paper Trade J., p. 53-57, Feb. 13, 1967. 49 refs.

The recovery of by-products from black liquor produced during the kraft pulping process is reviewed. Tall oil and turpentine are the major constituents, but considerable amounts of sulfur components and lignin are also recovered. Methods of separating the components from black liquor, various derivatives of each component, methods of producing these derivatives and their uses are discussed. A bibliography of 48 references is included.

15093

Persson, Goran

AIR POLLUTION. (Ilman Saastuminen). Text in Finnish. Teknillinen Aikakauslehti, no. 4:29-35, April 1969.

In Sweden, rainwater was analyzed for acidity and sulfate content. The relationship between sulfate emission and sulfate content of the atmosphere is not clear. Acidity runs ahead of sulfate content, possibly due to errors in pH measurement. Lakes have been polluted with acid rain to the point that fish died. Lichens, which constitute reindeer pasture and are extremely sensitive to pH changes, have been endangered. Forestry and agriculture are not yet affected. The average rate of trash disposal in Scandinavia is 300 kg/person/year. In 1967, Sweden consumed 201,000 tons of plastics, 20% chlorine-bearing. In Scandinavia, the three heaviest industrial offenders are pulp, metallurgy, and quarries. On July 1, 1969, a new anti-pollution law was passed in Sweden. Industries dangerous to their environment cannot be built without permission. Present factories will eventually be affected. After 1971, gasoline and diesel vehicles must conform to standards. The sulfur content of fuel oil will be limited to 2.5%, and by January 1970, the lead content of gasoline will be limited to 0.7 g per liter.

42686

Ministerium fuer Arbeits, Gesundheit and Soziales des Landes Nordrhein-Westfalen, Duesseldorf (West Germany)

PROBLEM NUMBER 1: THE ALTERED ENVIRONMENT. (Gestoerte Umwelt - das Problem Nr. 1). Text in German. In: Reine Luft fuer morgen. Utopie oder Wirklichkeit. Moehnesee-Wamel, West Germany, K. von Saint-George, 1972, p. 7-13.

General problems of environmental pollution are outlined. While the rate of population growth from 1950 to 1970 was 20%, energy consumption rose by 300%, electricity production by 500%, and expansions of paper manufacturing by 400%. The rapid industrial growth took place at the expense of nature and environment, causing air and water pollution and other problems. Some 4 million tons of dust and soot, 8 million tons of carbon monoxide, 4 million tons of sulfur dioxide, as well as 2 million tons of hydrocarbons and nitrogen oxides each, are discharged yearly to the atmosphere in West Germany. Air pollution affects man, animals, vegetation, and buildings. The radioactive contamination due to nuclear power plants and other facilities is negligible in comparison with the natural background. A survey revealed that a large proportion of people who had left the Ruhr area did so on account of polluted air. An abatement of air pollution as a result of improved technologies and the intensive use of pollution-control techniques has been apparent for the last years. A clean-air maintenance program has been elaborated for North Rhine-Westphalia.

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